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NATIONAL DAM SAFETY PROGRAM. PAULINS KILL DAM (NJ-00274), DELAW--ETC(U)
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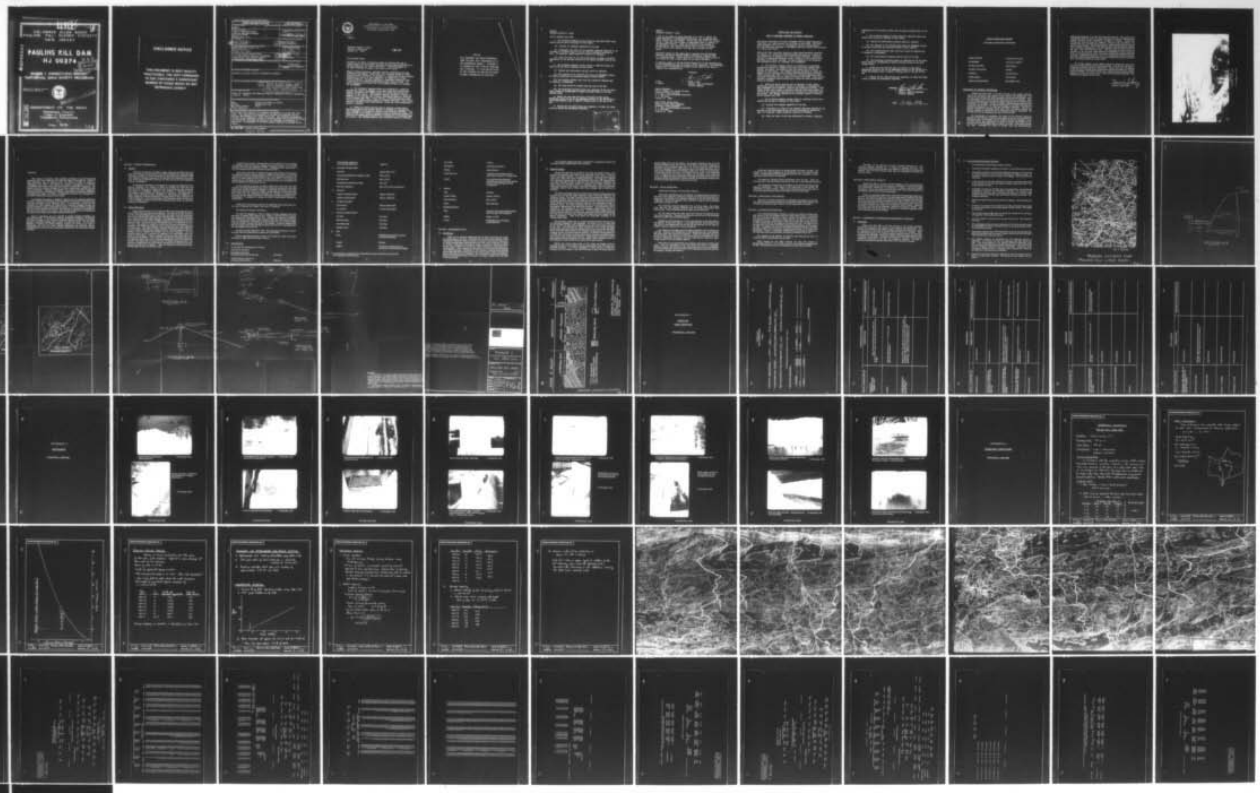

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DELAWARE RIVER BASIN
PAULINS KILL, SUSSEX COUNTY
NEW JERSEY

PAULINS KILL DAM
NJ 00274

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

May, 1979

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REPORT DOCUMENTATION PAGE

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Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

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Spillway
Structural Analysis
Visual Inspection
National Dam Safety Act Report
Paulkins Kill Dam
Safety

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE – 2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

4 MAY 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Paulins Kill Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Paulins Kill Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 33 percent of the Probable Maximum Flood would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated

within calendar year 1980.

c. The following remedial actions should be completed within three months from the date of approval of this report:

(1) Increase the drawdown capability of the dam.

(2) Investigate the effect of the sediment deposited upstream of the spillway on the functioning of the low level sluiceway by opening the gate. If necessary, remove excessive siltation by dredging.

(3) Lower the level of the lake sufficiently to permit a detailed examination of the spillway section and rip-rapped upstream slope of the dam.

d. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Spalled and deteriorated concrete should be repaired.

(2) The junction of the spillway side walls and embankment should be suitably backfilled and protected against further erosion.

(3) The cracked spillway right side wall should be repaired and, if necessary, strengthened.

(4) All trees should be removed from the area of the dam.

(5) The footbridge providing access for operation of the low level outlet should be strengthened to ensure continued access to the gate operator stand.

e. Within one year from the date of approval of this report, depressions along the top of the embankment section of the dam should be filled and measures taken to ensure a uniform level of the top of the dam.

f. Operate the low level outlet gate regularly, at least two times a year to ensure its operational condition.

NAPEN-D
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofmann, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
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PAULINS KILL DAM (NJ00274)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 and 21 December 1978 by Langan Engineering Associates, Inc. under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Paulins Kill Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 33 percent of the Probable Maximum Flood would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The following remedial actions should be completed within three months from the date of approval of this report:

(1) Increase the drawdown capability of the dam.

(2) Investigate the effect of the sediment deposited upstream of the spillway on the functioning of the low level sluiceway by opening the gate. If necessary, remove excessive siltation by dredging.

(3) Lower the level of the lake sufficiently to permit a detailed

examination of the spillway section and rip-rapped upstream slope of the dam.

d. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Spalled and deteriorated concrete should be repaired.

(2) The junction of the spillway side walls and embankment should be suitably backfilled and protected against further erosion.

(3) The cracked spillway right side wall should be repaired and, if necessary, strengthened.

(4) All trees should be removed from the area of the dam.

(5) The footbridge providing access for operation of the low level outlet should be strengthened to ensure continued access to the gate operator stand.

e. Within one year from the date of approval of this report, depressions along the top of the embankment section of the dam should be filled and measures taken to ensure a uniform level of the top of the dam.

f. Operate the low level outlet gate regularly, at least two times a year to ensure its operational condition.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 4 May 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	PAULINS KILL DAM
ID NUMBER:	Fed ID No. NJ00274
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	PAULINS KILL
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	DECEMBER 1978

ASSESSMENT OF GENERAL CONDITIONS

Paulins Kill Lake Dam is 52 years old and in fair overall condition. Erosion has occurred at the junction of the spillway and embankment. The concrete of the spillway side walls has spalled, cracked and deteriorated. There are depressions in the crest of the dam that also serves as a footpath. There has been deterioration of the spillway surface concrete and the concrete piers supporting the footbridge. Amount of sediment deposited along upstream side of spillway may be high. No essential information is available concerning the engineering properties of the dam and foundation materials. The dam is presently considered marginally stable under static and seismic loading. The spillway capacity as determined by CE Screening criteria is inadequate. We estimate the dam can adequately pass only 32% of the PMF.

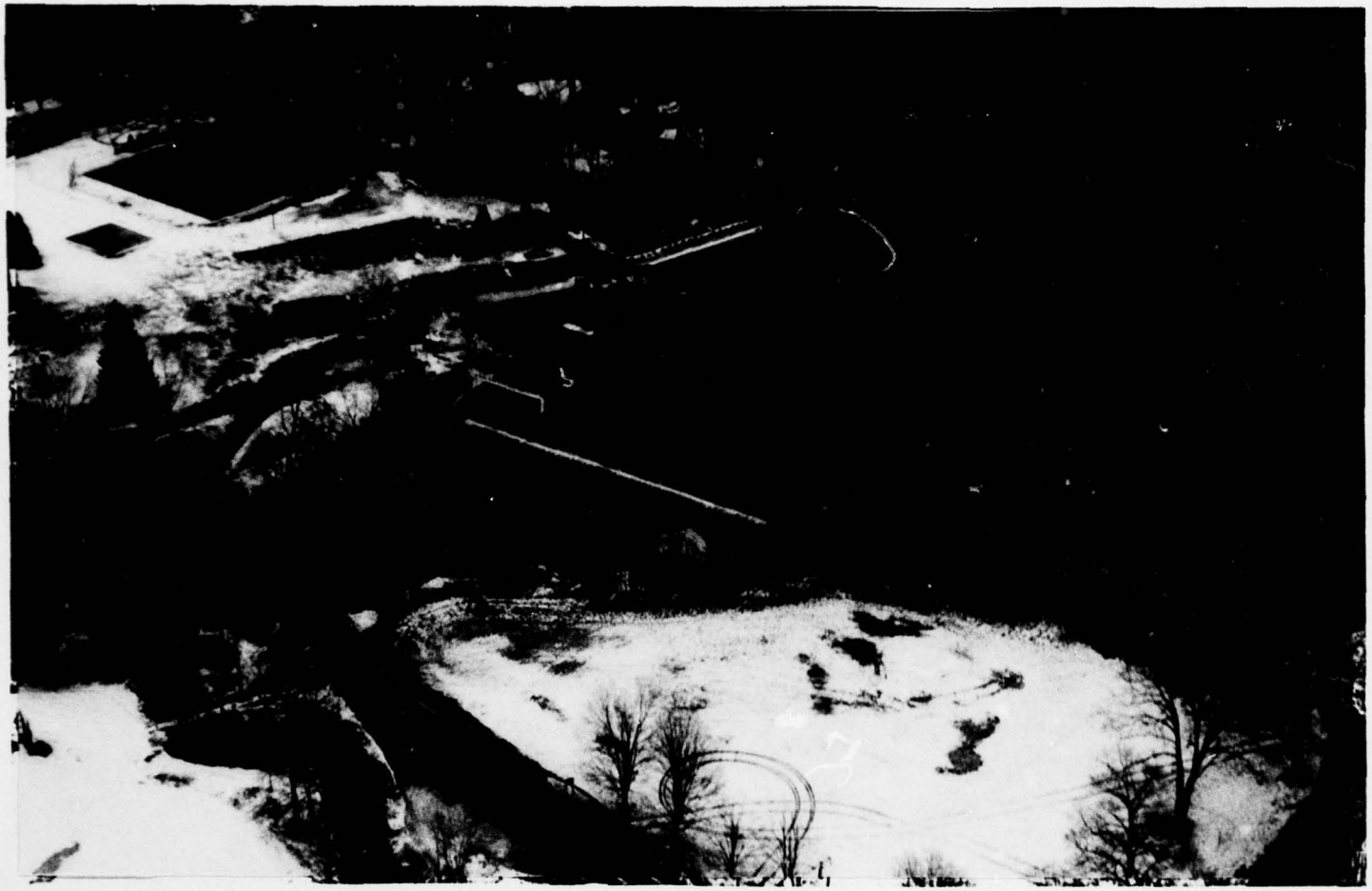
We recommend to investigate the effect of the sediment deposited upstream of the spillway towards the functioning of the low level sluiceway by opening the gate. If necessary, remove excessive siltation by dredging. Lower the level of the lake sufficiently to permit a detailed examination of the spillway section and riprapped upstream slope of the dam. These should be done very soon. Investigate by means of borings, tests and piezometers,the

engineering properties of the dam and foundation materials. The results of this investigation should be used to evaluate the stability of the dam under different loading conditions using conventional methods of analysis. Spalled and deteriorated concrete should be repaired. Erosion at the junctions of the spillway side walls and embankment should be suitably backfilled and protected against further erosion. The cracked spillway right side wall should be repaired and if necessary strengthened. All trees should be removed from the area of the dam. This should be done soon. The footbridge providing access for operation of the low level outlet should be strengthened to ensure continued access to the gate operator stand. The above recommended measures should be done soon. Depressions along the top of the embankment section of the dam should be filled and measures taken to ensure a uniform level of the top of the dam. This should be done in the near future.

The actual capacity of the spillway should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided and a warning system established. This should be done soon. Operate the low level outlet gate regularly, at least two times a year to ensure its operational condition. This should be done regularly in the future.

Dennis J. Leary

Dennis J. Leary, P.E.



OVERVIEW
PAULINS KILL DAM

13 December 1978

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	PAULINS KILL DAM
ID NUMBER:	Fed ID No. NJ00274
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	PAULINS KILL
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	DECEMBER 1978

LANGAN ENGINEERING ASSOCIATES, INC.

Consulting Civil Engineers
990 CLIFTON AVENUE
CLIFTON, NEW JERSEY

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NATIONAL DAM SAFETY REPORT

PAULINS KILL LAKE DAM FED ID NO NJ00274

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SECTION 1 PROJECT INFORMATION

1.1 General

Authority to perform the Phase I Safety Inspection of Paulins Kill Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 20 November 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the US Army Engineers District, Philadelphia.

The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Paulins Kill Lake Dam and appurtenances based upon available data and visual inspection, and, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment is made using screening criteria established in Recommended Guidelines for Safety Inspection of Dams prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection report to imply that a dam meeting or failing to meet the screening criteria, is per se, certainly adequate or inadequate.

1.2 Project Description

Paulins Kill Lake Dam is a 52 year old 450-ft-long, 29-ft-high earth dam with a 200-ft-long concrete overfall spillway. The crest of the dam is about 6 ft wide. The earth embankment is reported to have been rolled and constructed with a 2H:1V downstream slope and 3H:1V upstream slope. The entire upstream face is reported to have been riprapped. The embankment portion of the dam has a concrete core wall with 2-in tongue and groove wood sheeting driven 16-ft below the wall. The top of the wall is reported to be 1.5 ft below the crest of the dam. The spillway is located to the north of the earth embankment. It is reported to be timber pile supported, with a stilling pool that is also supported by timber piles. Steel sheet piling is reported to have been driven below the upstream edge of the spillway to refusal at 20 ft. This sheet piling was driven a distance of 20 ft beyond the spillway into the north abutment. Six inch diameter drains on 20 ft centers are reported to be immediately below the bottom of the spillway. There is a gated 3-ft-dia low level outlet pipe at the north side of the spillway. The outlet has a flat upstream sluice gate with stem and operator stand at the end of a walkway leading from the north abutment of the dam. The outlet invert is reported to be 15 ft below the spillway crest. The walkway is supported by the north spillway headwall and by reinforced concrete piers on the crest of the spillway. There is a fishway at the north end of the spillway where it joins the abutment wall.

Paulins Kill Lake Dam is located about 3 miles upstream from the Village of Stillwater, north of Route 94 in Sussex County, New Jersey. It is at north latitude 41° 3.1' and west longitude 74° 49.6'. A regional vicinity map is given in Fig 1 and essential features of the dam are given in Fig 2.

Paulins Kill Lake Dam is classified as being "Intermediate" on the basis of its maximum reservoir storage volume of 2000 acre-feet, which is more than 1,000-acre feet, but less than 50,000-acre feet. It is classified as "Small" on the basis of its total height of 29 ft, which is less than 40 feet. The overall size classification is the larger of these two determinations, and accordingly the dam is classified as "Intermediate" in size.

In the National Inventory of Dams, Paulins Kill Lake Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive property damage to residences downstream, and could potentially cause more than a few deaths. Visual inspection of the downstream area shows that the residential dwellings are located in relatively high elevations and the Paulins Kill Road is a very lightly travelled secondary road. Accordingly, it is proposed to change the Hazard Classification Potential to "Significant".

Paulins Kill Lake Dam is owned by the Paulinskill Lake Association, Inc., P.O. Box 71, Newton, N.J. 07860. Attn: Mr. C. Casterline.

The purpose of the dam is recreation.

The dam was designed in 1926 by Snook & Hardin, Engineers and Land Surveyors, 35 Spring Street, Newton, N.J. 07860. It was built by F.W. Schweirs and construction was completed in 1927. Leakage was reported immediately after construction and filling. About 10 gpm of clear flow was observed coming from the downstream toe behind the north wing wall, and a little leakage occurred through a construction joint in the spillway. The clear leakage from the toe is said to have been through the sheet pile wall and it was determined that the leakage was not serious.

The dam was last repaired in 1974. The operating mechanism of the low level gate valve was repaired and a trash rack was installed.

Normal operating procedures consist of lowering the water level when necessary for algae control and repair of docks.

1.3 Pertinent Data

a. At dam site, the drainage area is 79 sq mi

Lake area is 170 acres

b. Discharge at Dam Site

Maximum known flood at dam site:	Not known
Ungated spillway capacity at maximum pool elevation:	12580 cfs

	Total spillway capacity at maximum pool elevation:	12580 cfs
c.	Elevation* (ft above MSL)	
	Top dam:	Approx. Elev. 461.7
	Normal pool (Assumed at spillway crest):	Elev. 455.23
	Spillway crest:	Elev. 455.23
	Streambed at centerline of dam:	Elev. 437
	Maximum tailwater:	Elev. 445 at time of inspection
d.	Reservoir	
	Length of maximum pool:	Approx. 16050 feet
	Length of normal pool:	Approx. 16000 feet
e.	Storage (acre-feet)	
	Normal pool:	1000 AF (estimated)
	Top of dam:	2120 AF (estimated)
f.	Reservoir Surface (acres)	
	Top dam:	176 Acres
	Maximum pool:	176 Acres
	Recreation pool:	170 Acres
	Spillway crest:	170 Acres
g.	Dam	
	Type:	Earthfill with concrete core wall and overfall spillway.
	Length:	450 feet
	Height:	18 feet from spillway crest to streambed, 29 feet structure height.

* All elevations are referenced to a benchmark elevation of 463.0 at the top of the north abutment wall (See Fig 2.)

Top width:	6 feet ±
Side slopes:	U/S 2H:1V; D/S 3H:1V
Zoning:	None observed
Impervious core:	Concrete core 10 inches wide at crest with a 4-ft-wide x 4-ft-high base.
Cutoff:	It is reported that steel sheet piling has been used under the spillway and 2-in wood sheeting under the embankment.

h. Spillway

Type:	Overfall
Length of Weir:	Approx. 200 feet
Crest elevation:	Elev. 455.23
Gates:	None observed

i. Regulating Outlets

Type:	Gated 36-in-dia pipe through spillway structure under footbridge pier.
Length:	Approx. 15 feet
Access:	Footbridge on top of spillway to gate operator.

SECTION 2 ENGINEERING DATA

2.1 Introduction

There are no essential engineering data available concerning the design and construction of the dam. Excavation for the core wall is reported to have encountered "yellowish clayey hard pan" at 4-ft and on the basis of observation of timber sheeting pulled during construction, "blue clay" is reported at a depth of 16 feet. A test pile at the spillway location is reported to have been driven 20 feet with 20 blows for the last two inches with a No. 6 McKiernan-Terry steam hammer. This is reported to have given 17.8 t/pile using the Engineering News Record formula. Calculation in the reference material dated 11/20/26 and initialed JNB show the piles at the toe of the spillway to have 18.4 t/pile and those at the heel to have 8.3 tons/pile. This would seem to indicate the spillway would tip downstream unless the factor of safety included with the ENR Formula was large.

The available engineering data is insufficient to adequately evaluate the existing and future performance of the structure.

2.2 Regional Geology

Paulins Kill Lake Dam is located in the Valley and Ridge Province. This province encompasses one-twelfth of the land area of the state - chiefly in Warren and Sussex Counties. It is characterized by a series of nearly parallel ridges and valleys that trend northeast-southwest. The ridges are underlain with northwest dipping Silurian and Devonian sandstones and conglomerates. The upper Delaware Valley is underlain with weak Devonian limestones and shales while the Kittatinny Valley is underlain with folded Cambrian and Ordovician limestones and shales. Kittatinny Mountain is the most prominent topographic feature and its nearly even crest averages 1600 to 1800 feet in elevation.

The Valley and Ridge Province is divided into western, middle, and eastern sections that include the Upper Delaware Valley, Kittatinny Mountain, and Kittatinny Valley. The Upper Delaware Valley encompasses the region west of Kittatinny Mountain that has been eroded in Devonian limestones and shales. Kittatinny Mountain makes up the middle section of the Province and forms the eastern border of the Upper Delaware Valley and the northwestern border of Kittatinny Valley. The ridge is underlain with the very resistant lower Silurian Shawangunk conglomerate and High Falls sandstone. The northeastern side is bordered by the escarpments of the Shawangunk conglomerate, which rise steeply from the Kittatinny Valley floor. The Shawangunk conglomerate has been extensively broken up into large rock fragments by mechanical weathering and frost action and forms mass wasted talus slopes along the ramparts of the eastern escarpment. These talus slopes are extensively developed in the Delaware Water Gap.

The Kittatinny Valley area is a broad northeast-southwest lowland where the Harrisburg Peneplain is well developed. The valley is 10 to 13 miles wide and lies between the New Jersey Highlands on the east and Kittatinny Mountain on the west. The Wisconsin ice sheet covered all of the Valley and Ridge Province and deposited a terminal moraine south of the province near Belvidere. Much of the land surface north of the terminal moraine consists of a thin sheet of glacial till and ice-scoured bedrock surfaces. In addition, fluvial deposits of stratified drift consisting of eskers, kames, kame terraces, and deltas mantle many of the areas of the valley bottoms. Discontinuous recessional moraines were deposited during stillstands in the ice retreat. These moraines now form a discontinuous low band of hills across nearly all of Sussex County.

Glacial till covers large areas of the Valley and Ridge Province. Generally, the till is extremely thin and sometimes present only in patches or as scattered boulders. It is best developed on broad summits, interstream surfaces, and in low passes or cols, and is thinnest or absent on steep slopes, on

narrow ridges, and in narrow valleys. The greatest thickness of the till in the Kittatinny Valley is over 100 feet just on the edge of the valley at Ogdensburg. Estimates of the thickness range from 8 to 10 feet along the west slope of Kittatinny Mountain; 2 to 3 feet along the crest of Kittatinny Mountain; 5 to 10 feet on the limestone belts of Kittatinny Valley; 8 to 12 feet on the shale belts of Kittatinny Valley; and from 5 to 20 feet in Vernon Valley. The composition of till is largely of local origin and reflects the character of the underlying rock. It is generally compact because of the high clay content derived from the weathered shales and has many resistant boulders of Shawangunk conglomerate as well as erratics derived from more distant sources.

SECTION 3 VISUAL INSPECTION

Paulins Kill Lake dam is in overall fair condition.

Lake water was flowing over the spillway with approximately 3-in head at the time of our inspection. However, moderate to extensive deterioration was observed on the surface of the spillway, especially in the area below the footbridge pier. Depth from spillway crest to bottom of lake (or top of sediment) was found to be about 7 feet.

The footbridge structure appeared to be in need of repair. The wooden hand rails are not securely fastened and the bolted connections have deteriorated. Concrete has spalled on the right concrete abutment.

The low level outlet was under water and could not be inspected at the time of our inspection. The gate stem located at the left end of the footbridge indicated the gate may be partially opened.

Spalling and deterioration of concrete was observed on the side walls of the spillway. Cracks were observed on the right side wall. The junctions of the side walls to the embankments on the left and the abutment on the right are eroded. Erosion as deep as 3 to 4 feet was observed.

The fishway at the right end of the spillway appeared to be in satisfactory condition. However, the stilling pool on the downstream side of the spillway was under water and could not be inspected. During our December 21st visit, portion of Lake water was diverted to the low area at the downstream toe of the earth embankment forming a small man-made lake by means of a water trough attached to the left spillway sidewall.

Both slopes of the embankment are overgrown with small to medium size trees. There are depressions in the crest which also serves as a footpath. Moderate erosion was observed on the downstream face of the embankment near the left abutment and on both sides of the embankment/abutment junction. No seepage or leakage was observed.

Numerous scattered homes are located along both sides of the lake. The stability of the slopes appeared to be satisfactory with only sporadic minor erosion. Besides sediment deposited against upstream face of spillway, no other significant sedimentation was observed.

No homes are located directly downstream from the dam. There are homes located in the downstream vicinity, but they are at relatively high elevations.

The downstream channel from the spillway to the Paulins Kill Road bridge appeared satisfactory. The slopes on the right bank in this section are moderately to heavily eroded. Trees, brush and leaves obstruct about half of the channel approximately 80 feet downstream from the road bridge.

SECTION 4 OPERATIONAL PROCEDURES

There are no formal operational or maintenance procedures for the dam. The lake level is lowered by means of the low level outlet when necessary for the control of weeds or repair of docks. No warning system is in effect.

SECTION 5 HYDRAULIC/HYDROLOGIC

The hydraulic/hydrologic evaluation is based on a Spillway Design Flood (SDF) equal to the full Probable Maximum Flood (PMF) chosen in accordance with the evaluation guidelines for dams classified as Significant Hazard and Intermediate in size. Hydrologic design data for this dam is not available. Available information indicates that a PMF with peak inflow of 100 cfs/sq mi (or 7900 cfs) was used for the design of the spillway and dam. This PMF is much less than that which would be obtained using present guidelines for determining the PMF. Accordingly, the PMF has been determined by developing a synthetic hydrograph based on the maximum probable precipitation of 22 inches (200 square mile - 24 hour). Hydrologic computations are presented in Appendix 4. The PMF peak inflow determined for the subject watershed is 40,207 cfs.

The capacity of the spillway at maximum pool elevation (El. 461.7) is 12,580 cfs which is significantly less than SDF.

Flood routing for the PMF indicates the dam will overtop by approximately 5.4 feet. For 1/2 PMF, the same will overtop by approximately 1.8 feet. We estimate the dam can adequately pass only 32% of the PMF.

Drawdown of the reservoir has been evaluated assuming the 36-in sluiceway operates probably and is utilized for lowering the lake. Our calculations indicate the sluiceway is not capable of lowering the lake below the spillway crest with the minimum inflow that can reasonably be expected to enter the Lake.

SECTION 6 STRUCTURAL STABILITY

Paulins Kill Dam is 52 years old and appears in fair overall condition. Visual observations did not disclose evidence of instability. The available design and construction information is insufficient to perform analytical stability evaluations. There are no operating records and post construction changes have consisted of repair of the low level outlet gate.

There is no available information concerning the engineering properties of the dam and foundation materials. The piles supporting the spillway have been rated at 17.8 t/pile according to the EN formula and calculations show the piles below the toe of the spillway are loaded to 18.4 t/pile. Present day knowledge concerning application of this formula indicates the spillway may have a very low factor of safety with respect to conventional safety margins. Additional information concerning the subsurface conditions and piling is needed. Until such information can be evaluated the spillway is considered marginally stable under both static and seismic loading.

SECTION 7 ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Assessment

Paulins Kill Lake Dam is 52 years old and in fair overall condition. Erosion has occurred at the junction of the spillway and embankment. The concrete of the spillway side walls has spalled, cracked and deteriorated. There are depressions in the crest of the dam that also serves as a footpath. There has been deterioration of the spillway surface concrete and the concrete piers supporting the footbridge. Amount of sediment deposited along upstream side of spillway may be high. No essential information is available concerning the engineering properties of the dam and foundation materials. The dam is presently considered marginally stable under static and seismic loading.

spillway section and riprapped upstream slope of the dam. These should be done very soon. Investigate by means of borings, tests and piezometers,the

7.2 Recommendations/Remedial Measures

We recommend the following remedial measures:

1. Increase the drawdown capability of the dam. This should be done very soon.

2. Investigate the effect of the sediment deposited upstream of the spillway on the functioning of the low level sluiceway by opening the gate. If necessary, remove excessive siltation by dredging. This should be done very soon.

3. Lower the level of the lake sufficiently to permit a detailed examination of the spillway section and rip-rapped upstream slope of the dam. This should be done very soon.

4. Investigate by means of borings, tests and piezometers, the engineering properties of the dam and foundation materials. The results of this investigation should be used to evaluate the stability of the dam under different loading conditions using conventional methods of analysis. This should be done soon.

5. Spalled and deteriorated concrete should be repaired. This should be done soon.

6. Erosion at the junction of the spillway side walls and embankment should be suitably backfilled and protected against further erosion. This should be done soon.

7. The cracked spillway right side wall should be repaired and if necessary strengthened. This should be done soon.

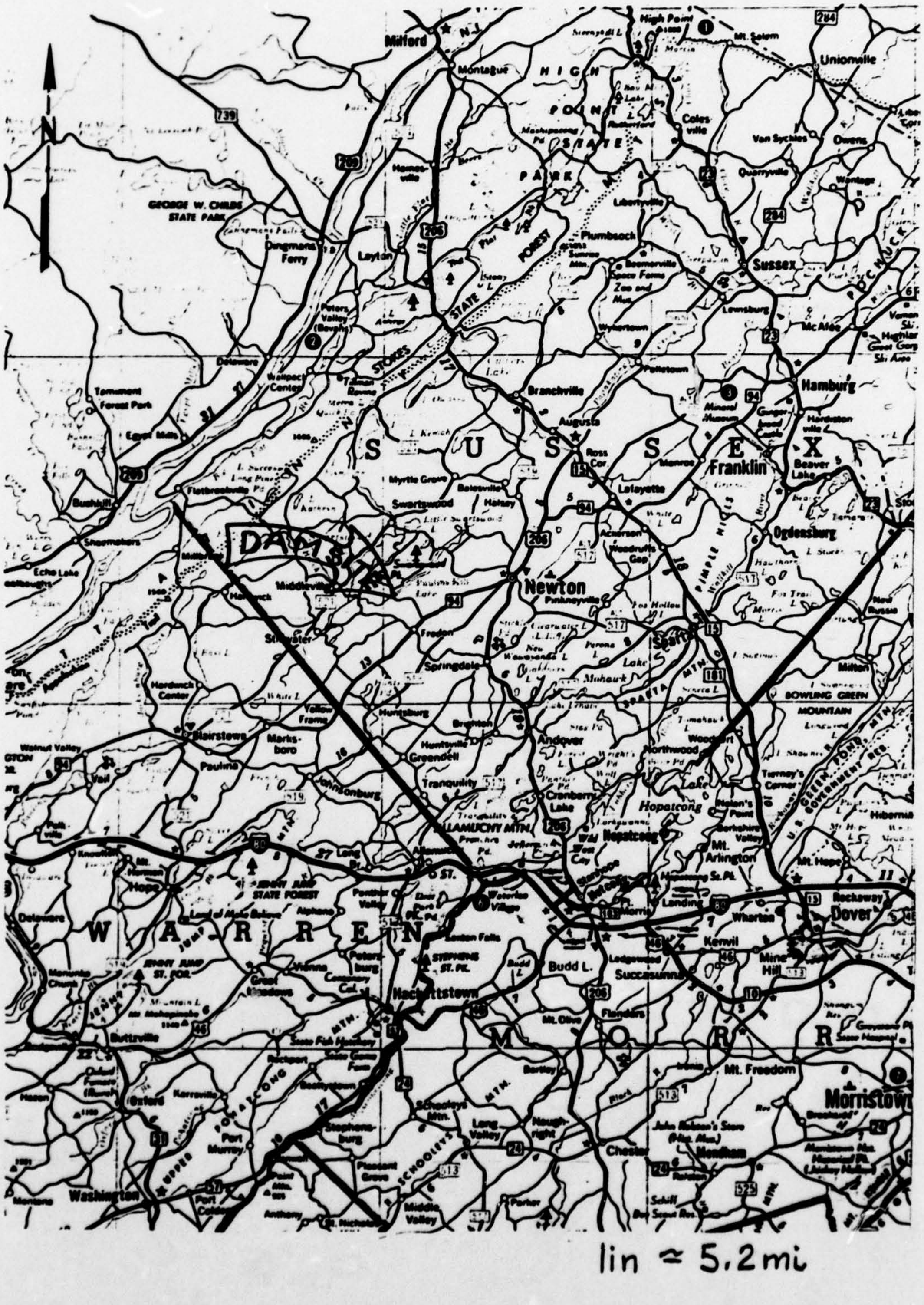
8. All trees should be removed from the area of the dam. This should be done soon.

9. The footbridge provides access for operation of the low level outlet should be strengthened to ensure continued access to the gate operator stand. This should be done soon.

10. Depressions along the top of the embankment section of the dam should be filled and measures taken to ensure a uniform level of the top of the dam. This should be done in the near future.

11. The spillway capacity as determined by CE screening criteria is inadequate. We estimate the dam can adequately pass only 32% of the PMF. The actual capacity of the spillway should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established.

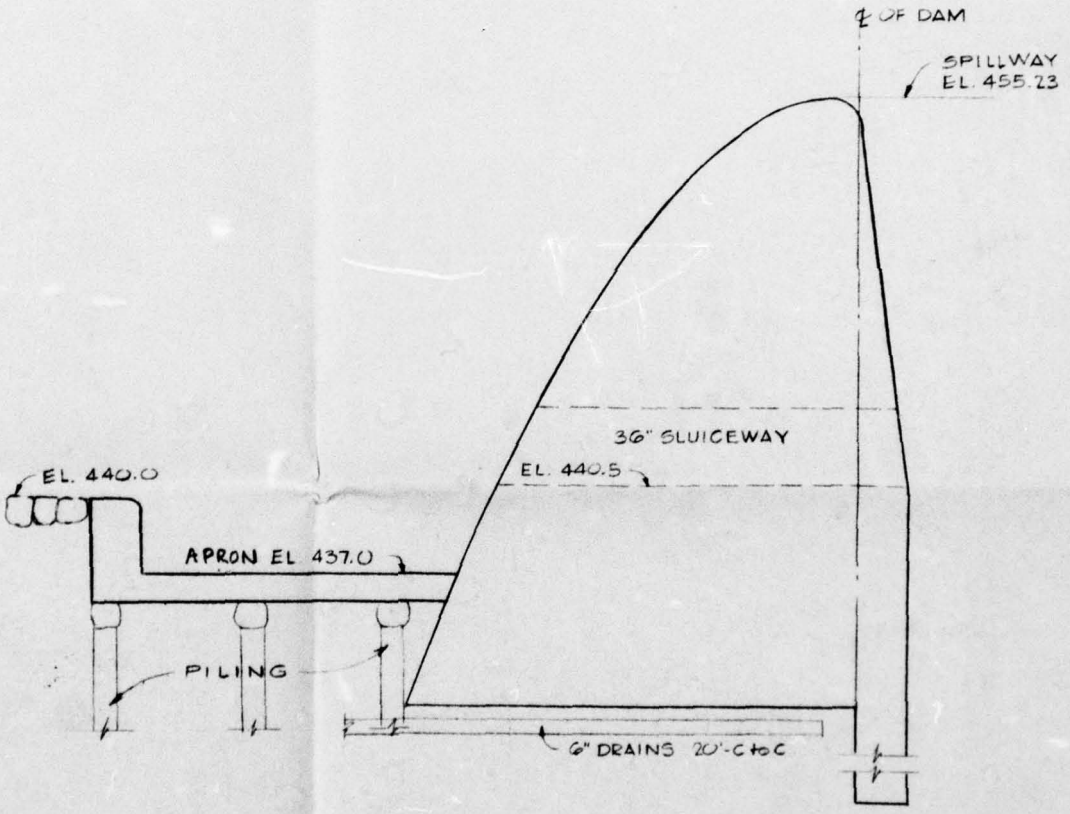
12. Operate the low level outlet gate regularly, at least two times a year to ensure its operational condition. This should be done regularly in the future.



1in ≈ 5.2mi

REGIONAL VICINITY MAP
PAULINS KILL LAKE DAM

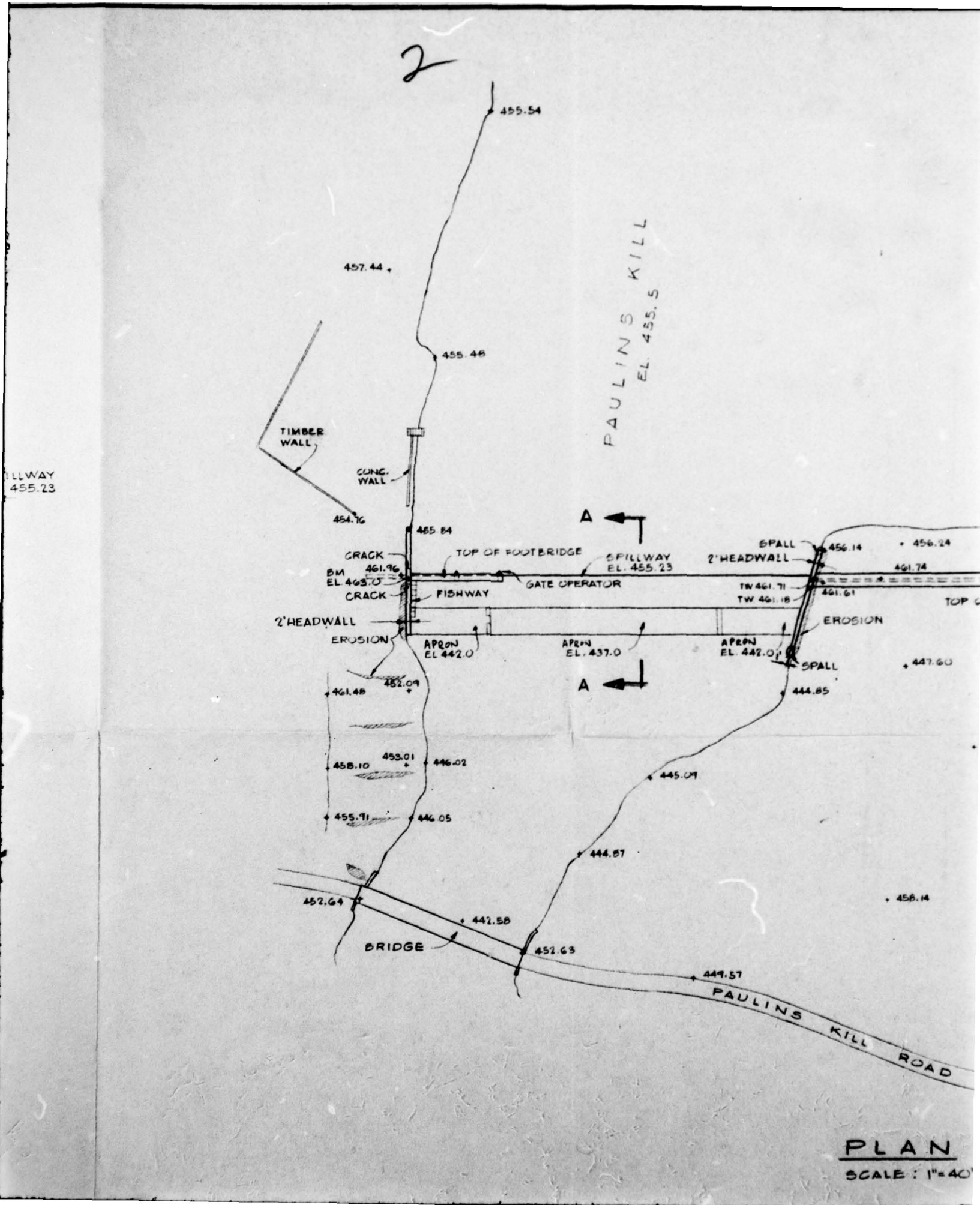
Fig. 1



SECTION A-A

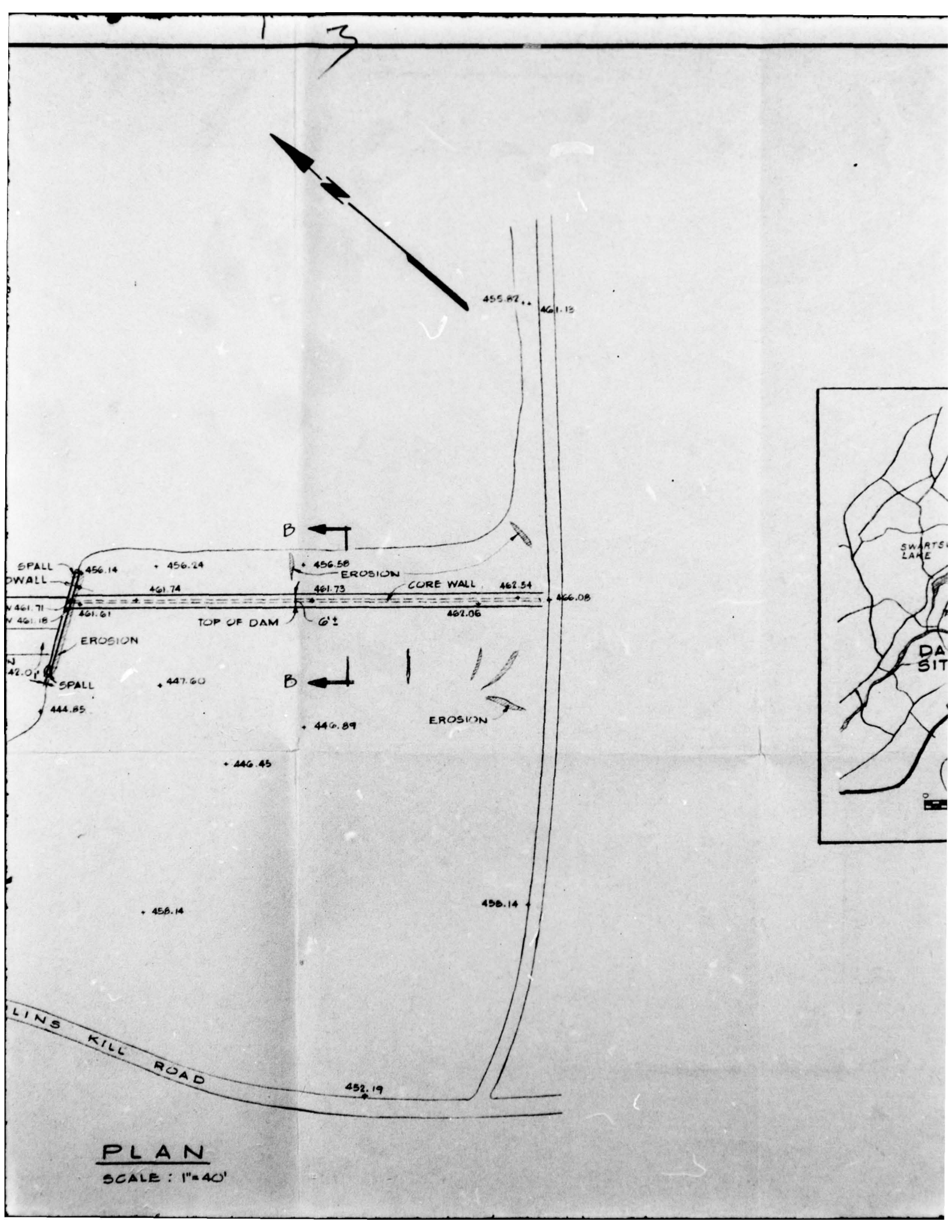
SCALE: 1" = 5'

2



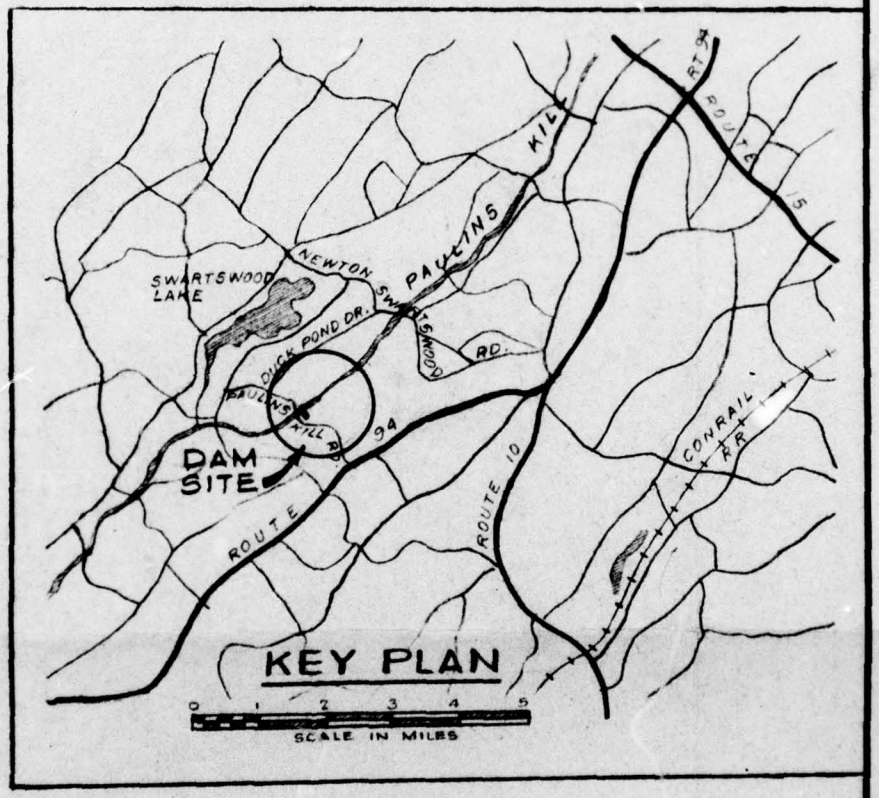
PLAN

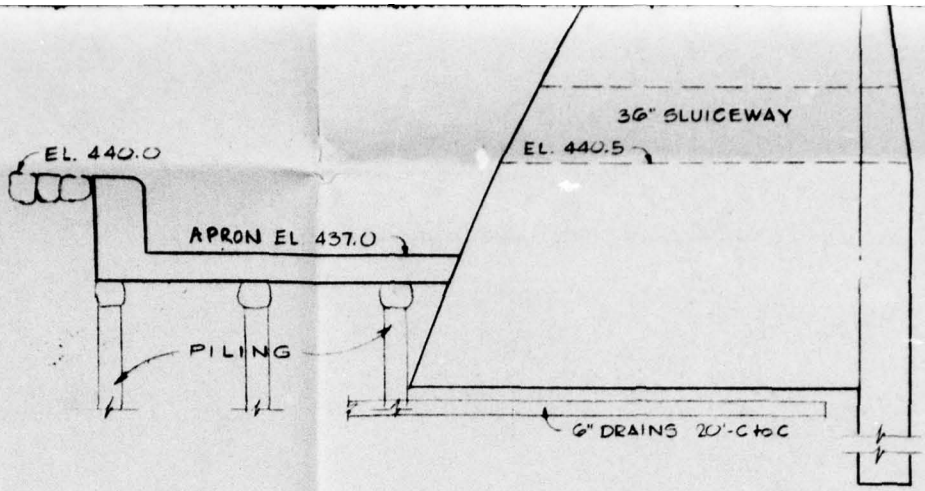
SCALE : 1"=40'


455.82
461.13
B
SPALL
WALL
456.14
456.24
456.58
EROSION
461.74
461.73
CORE WALL
462.54
466.08
461.71
461.18
461.61
TOP OF DAM
6'±
462.06
EROSION
42.0'
SPALL
447.60
B
444.85
446.89
EROSION
446.45
458.14
458.14
LINS KILL ROAD
452.19
SWARTS
LAKE
DA
SIT
PLAN
SCALE : 1"=40'

4611.13

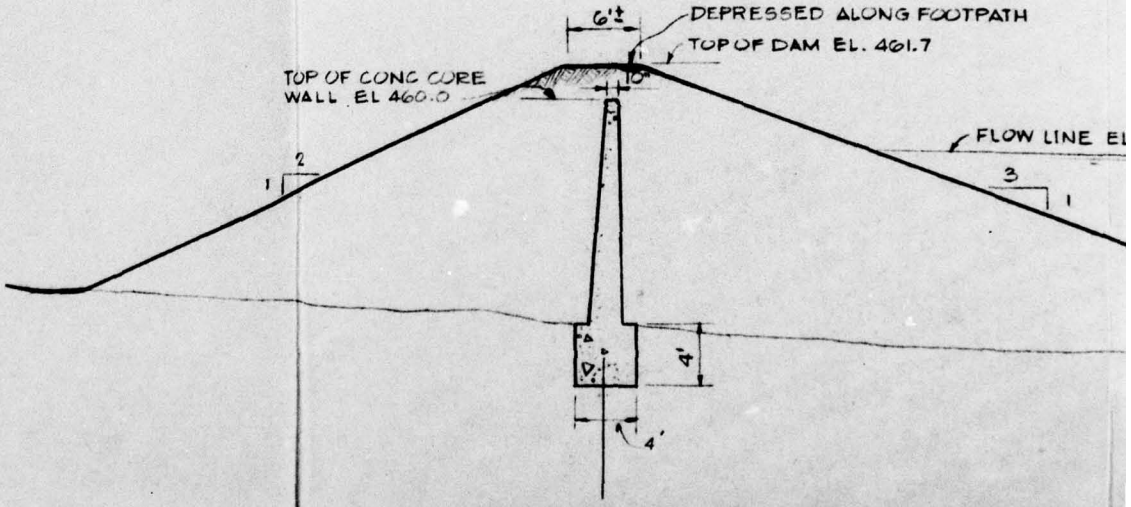
4666.08





SECTION A-A

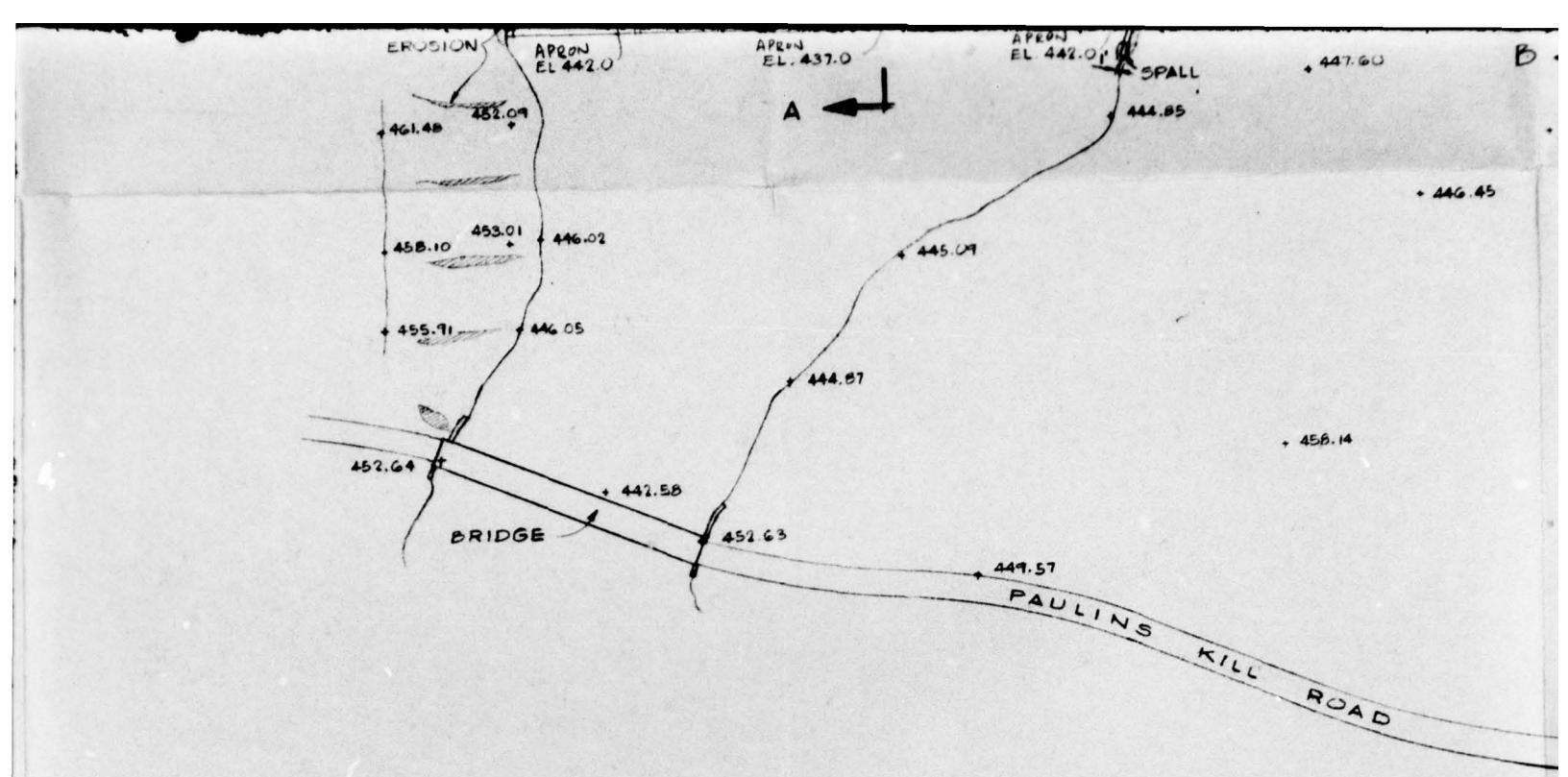
SCALE: 1" = 5'



SECTION B-B

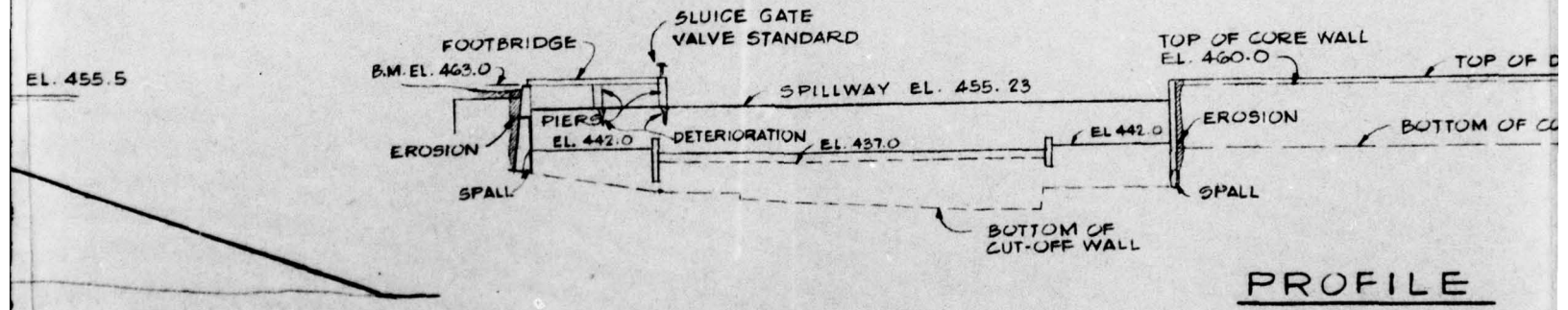
SCALE: 1" = 10'

5



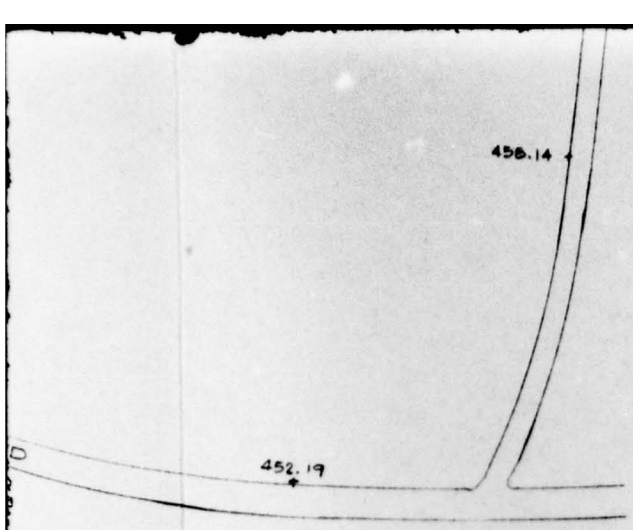
PLAN

SCALE : 1"=40'



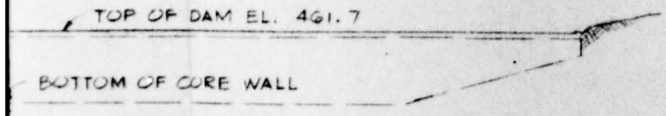
PROFILE

SCALE: HORIZ: 1"=40'
VERT: 1"=40'



N

= 40'



ILE

RIZ: 1"=40'
RT: 1"=40'

1

NOTE:

THE ELEVATIONS SHOWN WERE OBTAINED USING A SURVEYO
TRANSIT AND LEVEL. THE BENCHMARK ELEVATION OF 463.0 ON THE
NORTH WINGWALL WAS USED AS WAS INDICATED ON THE DRAWINGS
ENTITLED "PAULINSKILL LAKE CORP. PLANS FOR DAM" AUGUST, 192
SNOOK & HARDIN ENGINEERS, NEWTON, N.J.. THESE ELEVATIONS A
APPROXIMATE. INFORMATION SHOWN BELOW GROUND SURFACE
WATER LEVEL ARE INFERRED ON THE BASIS OF THE ABOVE MENT
DRAWINGS.

CONSTRUCTION REPORT INDICATES THAT 2-IN TONGUE & GROOVE WOOD
HAD BEEN DRIVEN 16-FT BELOW THE CONCRETE CORE WALL IN THE EMBANKM

ELEVATIONS SHOWN WERE OBTAINED USING A SURVEYOR'S
ND LEVEL. THE BENCHMARK ELEVATION OF 463.0 ON THE
NGWALL WAS USED AS WAS INDICATED ON THE DRAWINGS
"PAULINSKILL LAKE CORP. PLANS FOR DAM" AUGUST, 1926
ARDIN ENGINEERS, NEWTON, N.J.. THESE ELEVATIONS ARE
ATE. INFORMATION SHOWN BELOW GROUND SURFACE AND
VEL ARE INFERRED ON THE BASIS OF THE ABOVE MENTIONED
5.

TRUCTION REPORT INDICATES THAT 2-IN TONGUE & GROOVE WOOD SHEETING
RIVEN 16-FT BELOW THE CONCRETE CORE WALL IN THE EMBANKMENT SECTION.

DATE	DESCRIPTION	NO.
REVISIONS		

PROJECT

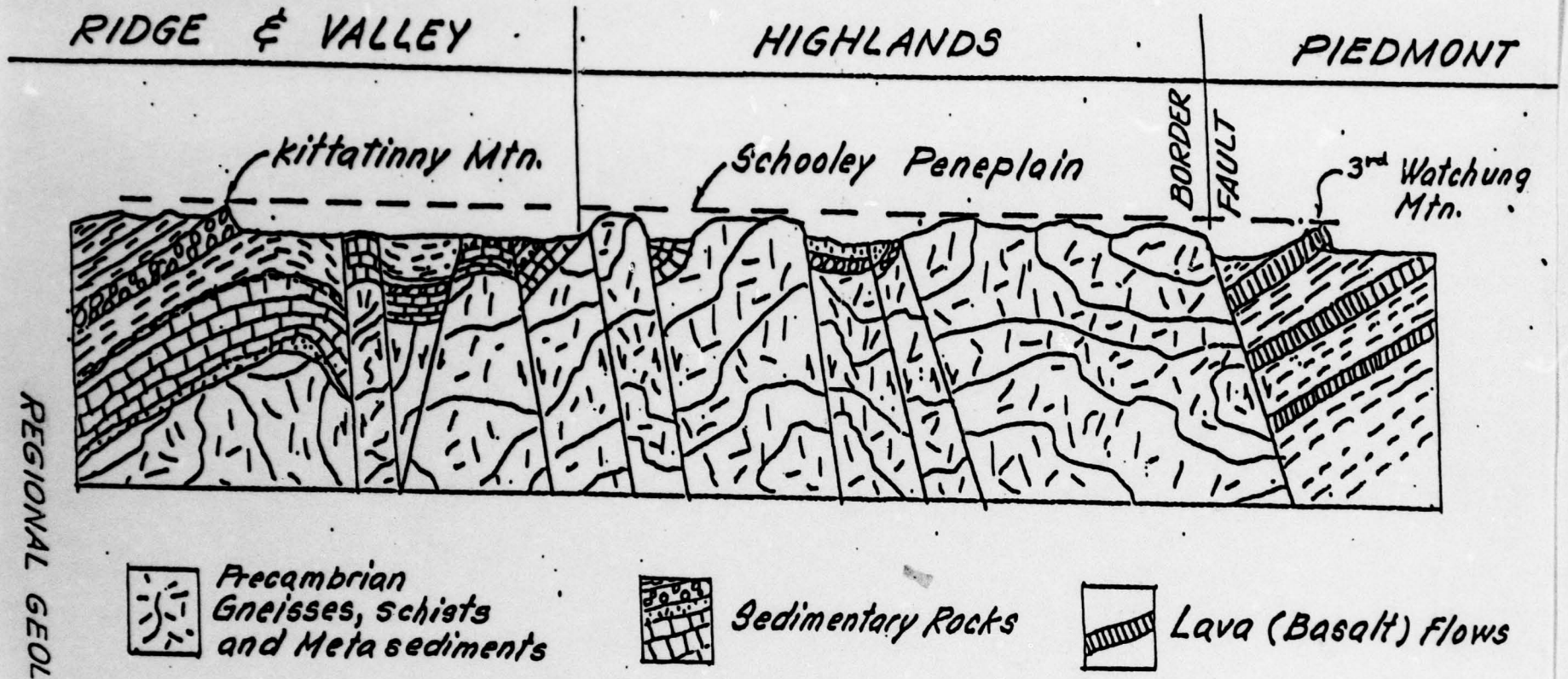
PHASE I
INSPECTION & EVALUATION
OF
NEW JERSEY DAMS

DRAWING TITLE

PAULINS KILL DAM

FEBRUARY 1979
FED. I. D. NO. NJ00274

JOB NO. J-7888	DRAWING NO. FIG 2
DATE 21 FEB 1979	
SCALE AS NOTED	
DRN. BY J. R.	
CHKD. BY D. J. L.	



Schematic Cross-section of Ridge & Valley Physiographic Province (After Wolfe; 1977)

Fig. 3

APPENDIX I

CHECK LIST

VISUAL INSPECTION

PAULINS KILL LAKE DAM

CHECK LIST
VISUAL INSPECTION
Phase I

NAME DAM Paulins Kill Dam COUNTY Sussex STATE New Jersey COORDINATORS N.J.D.E.P.

DATE(s) INSPECTION See Below WEATHER Partly Cloudy & windy TEMPERATURE 40° F

POOL ELEVATION AT TIME OF INSPECTION 455.5* M.S.L. TAILWATER AT TIME OF INSPECTION 445* M.S.L.

* Elevations based on BM of El. 463 (Ref. Fig. 2)

INSPECTION PERSONNEL:

J. Richards	12/21/78 12/12/78	C. Campbell	12/12/78	
P. Yu	12/21/78	D. Leary	12/21/78	
J. Rizzo	12/12/78			

Peter Yu RECORDER

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Trees, brush and leaves obstruct about half of the channel approx. 80 feet downstream from road bridge.	Obstructions in channel should be removed.
SLOPES	Several eroded areas up to 1 ft in depth along right bank downstream.	Eroded areas should be filled.
APPROXIMATE NO. OF HOMES AND POPULATION	Based on USGS Topo Map and visual inspection, homes immediately downstream from the lake are located on high elevations. Village of Stillwater approx. 3 miles downstream, population estimated about 150.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None Observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None Observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Slopes eroded at several locations downstream. Erosion on both faces of embankment at left abutment/embankment junction.	Eroded areas should be suitably filled.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Footpath on crest of embankment has several depressed areas.	Depressed areas should be suitably filled.
RIPRAP FAILURES	None Observed	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Spillway/abutment junction heavily eroded, left and right.	Erosion at spillway/abutment junctions should be filled.
ANY NOTICEABLE SEEPAGE	None Observed	
STAFF GAGE AND RECORDER	None Observed	
DRAINS	None Observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None Observed	
INTAKE STRUCTURE	Operator appeared partially opened and recently greased. Other appurtenances not observed.	
OUTLET STRUCTURE	None Observed	
OUTLET CHANNEL	Appears satisfactory	
EMERGENCY GATE	None Observed	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARK OR RECOMMENDATIONS
SLOPES	Appear satisfactory	
SEDIMENTATION	Sedimentation along upstream side of spillway, approximately 7 ft from spillway crest to top of sediment.	Sediment should be removed.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete deteriorated on surfaces of spillway and downstream of piers for foot bridge.	Concrete should be repaired.
APPROACH CHANNEL	None Observed	
DISCHARGE CHANNEL	Appears satisfactory.	
BRIDGE AND PIERS	Foot-bridge wooden planks and connections deteriorated at several locations, including detached railing and deteriorated bolt. Gage located on mid-footbridge pier is indiscernible above water level.	Deteriorated and detached appurtenances should be repaired. Gage should be reconditioned.
RIGHT WING WALL	0.5 in to 1.5 in crack along top extending down both sides, concrete spalled and surface deteriorated up to 2 ft long. Concrete spalled on the downstream of wall from bottom to 4 ft high.	Spalled and deteriorated concrete should be repaired.
LEFT WING WALL	Concrete generally spalled and deteriorated.	Concrete should be repaired.

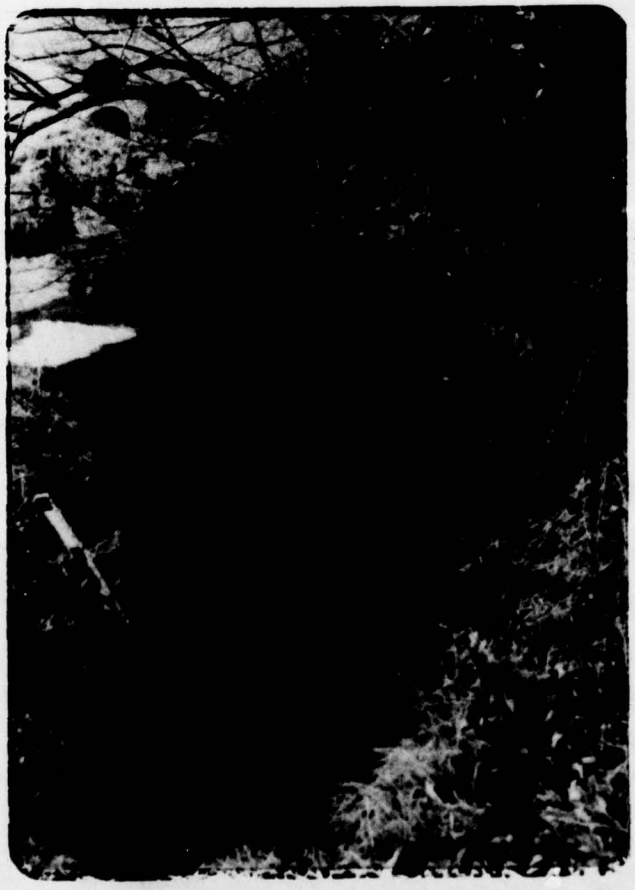
APPENDIX 2

PHOTOGRAPHS

PAULINS KILL LAKE DAM

Right abutment and spillway.
Looking upstream

21 December 1978



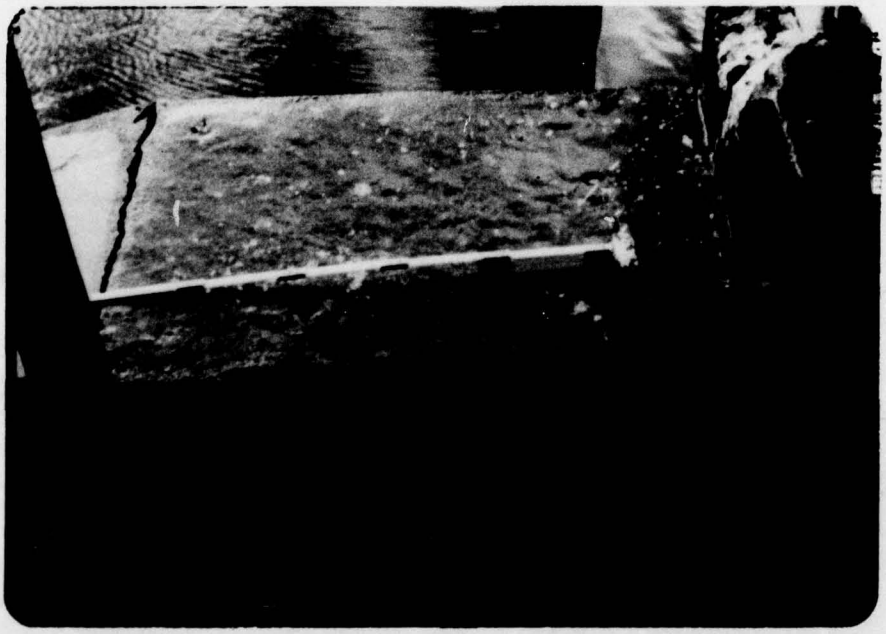
Erosion at junction of abutment and embankment. Looking downstream.

21 December 1978

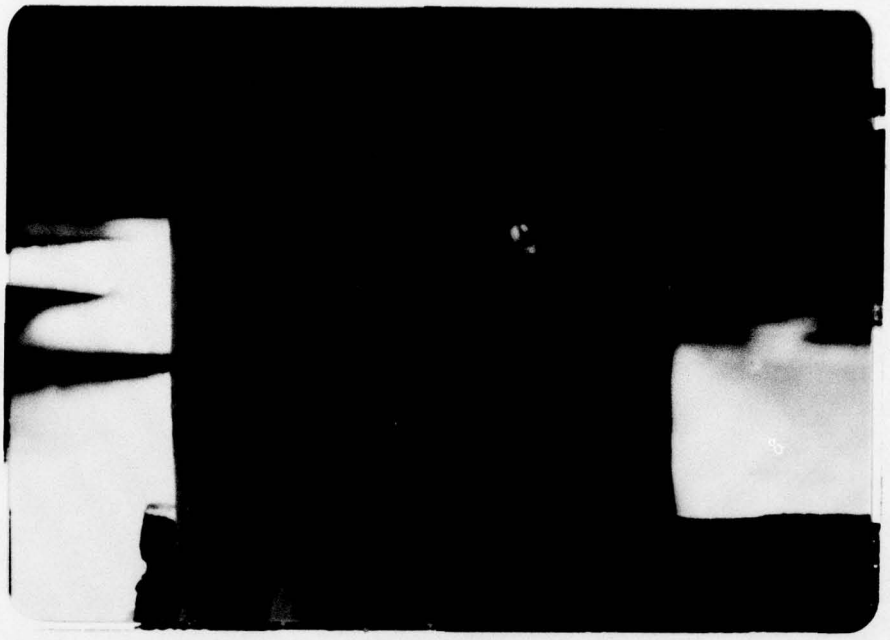
Footbridge and low level gate operator stand at left side of photo. 21 December 1978

Crakcs in right side wall of spillway. 21 December 1978

Deteriorated Footbridge planks and detached railing. 21 December 1978



Cracks in right side wall of spillway. 21 December 1978



Deteriorated bolt under footbridge. 21 December 1978

Piers supporting footbridge. Concrete spalled downstream. Note water level gage on pier. Looking right to left. 21 December 1978

Erosion and deteriorated of concrete at left spillway side wall. Looking upstream.

21 December 1978

Deterioration of concrete at downstream portion of left spillway sidewall.

21 December 1978

Erosion and spalled concrete at junction of spillway sidewall and embankment.

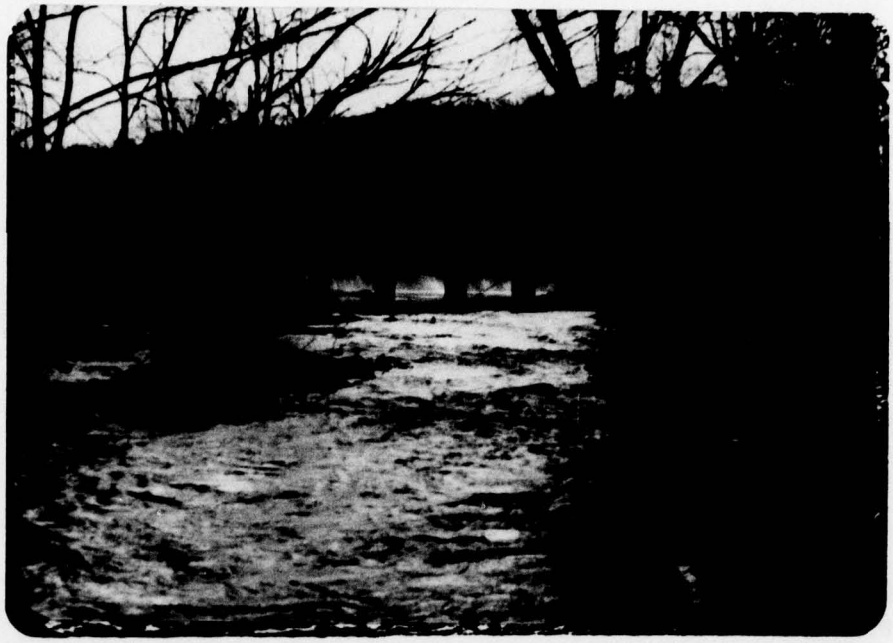
21 December 1978

Water trough attached to left spillway side wall. Looking downstream.

21 December 1978

Water from trough flows to basin located left of downstream channel. 21 December 1978

Reservoir slopes and lake. Looking upstream from footbridge. 21 December 1978



Spillway, Paulins Kill Road Bridge and downstream channel. Looking upstream. 21 December 1978

Downstream channel and Paulins Kill Road Bridge viewed from left abutment. 21 December 1978

APPENDIX 3

HYDROLOGIC COMPUTATIONS

PAULINS KILL LAKE DAM

LANGAN ENGINEERING ASSOCIATES, INC.

HYDROLOGIC COMPUTATIONS

PAULINS KILL LAKE DAM

Location : Sussex County, N.J.

Drainage Area : 79 sq. mi.

Lake Area : 170 Ac.

Classification : size - Intermediate
hazard - Significant

Spillway Design Flood :

In accordance with the evaluation criteria, PMF is chosen to be used. Based on available information, the spillway and dam was designed on the basis of a flood with peak inflow of 100 cfs/sq mi (or 7900 cfs). This peak inflow is considered to be much smaller than that of the PMF determined using present present guideline. Therefor PMF is determined accordingly.

COMPUTE PMF

1. Dam located in zone 1 (south boundary)
   PMP = 22 inches

2. PMF must be adjusted for basin size (since dam locates close to zone 6, ∴ take average)

Duration	% Factor (for 79 mi²) Zone 1	Zone 6	Average	Reduction Factor
0-6	86	92	89	
0-12	100	101	101	0.862
0-24	111	111	111	
0-48	117	124	121	

UNIT HYDROGRAPH

Corp of Engineers has indicated that Snyder Method be used and recommended the following coefficients:

$C_t = 2.82$, $C_p = 0.62$

Snyder Lag time:

$t_p = C_t (L \cdot L_{ca})^{0.3}$

from drainage area

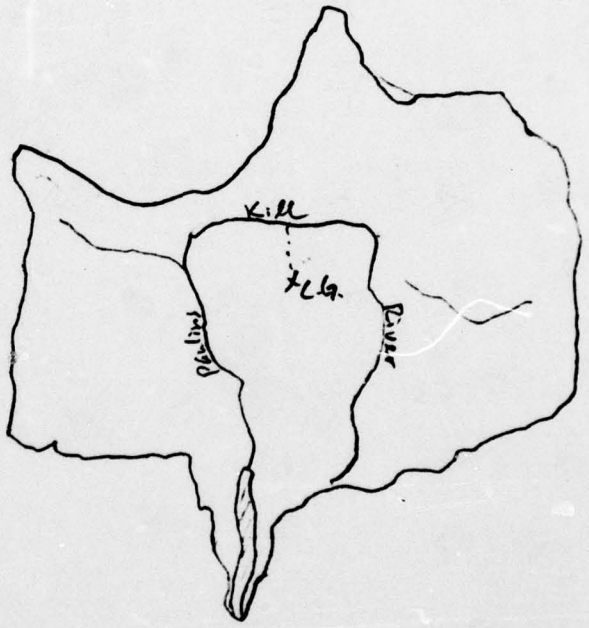
$L = 100000$ ft $= 19$ mi

$L_{ca} = 50000$ ft $= 9.5$ mi

$\therefore t_p = 2.82 (19 \times 9.5)^{0.3}$

$= 13.4$ hrs

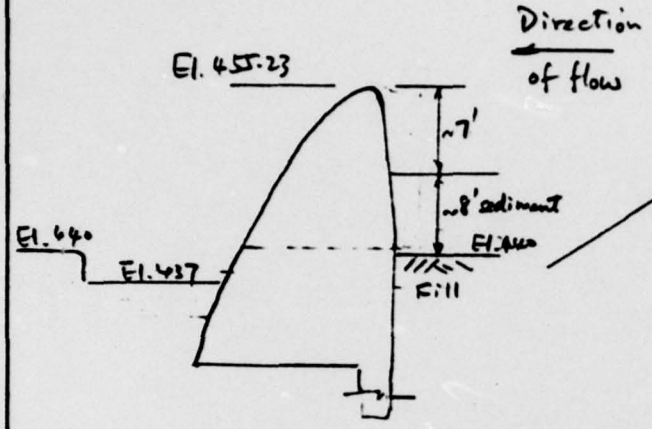
$C_p = 0.62$



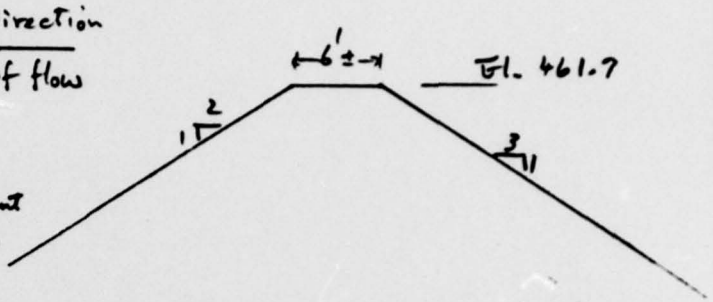
LANGAN ENGINEERING ASSOCIATES, INC.

SPILLWAY CAPACITY

Spillway Section (Ogee)



Embankment Section



$Q = cLH^{3/2}$

Determine Co for discharge equation from "Design of Small Dams" Fig. 249 on Pg. 378

Based on spillway section and available information,

estimate $H_o = 4$ ft $\therefore \frac{P}{H_o} = \frac{7}{4} = 1.75$

$\therefore C_o \doteq 3.92$

Determine the coefficient-head relation from Fig. 250 of 'D.S.D.'

Length of Spillway (less footbridge pair*) = 195 ft

Embankment section resembles weir of trapezoidal cross-section with both face inclined. Obtain C value with reference to Table 5-9 of 'Handbook of Hydraulics' by King & Brater. Due to the presence of trees on the embankment, choose $C_{avg} = 2.9$, Effective L = 240 ft

* footbridge structure located on top of spillway at right (north-west) abutment area. (See Fig. 2 of report)

BY DJY DATE 2-22-79 Dawlins Kill Lake Dam JOB NO. I-783 B

CKD GED DATE 4-19-79 SHEET NO. 3 OF 10

LANGAN ENGINEERING ASSOCIATES, INC.

Elev. (ft)	Spillway					Embankment		Total (cfs)
	H (ft)	H/H_o	C/C_o	C	Q_s (cfs)	H (ft)	Q_d (cfs)	$Q_T = Q_s + Q_d$
455.23	0							0
456.23	1	0.25	0.87	3.41	665			665
457.23	2	0.5	0.92	3.61	1991			1991
458.23	3	0.75	0.96	3.76	3810			3810
459.23	4	1.0	1.00	3.92	6115			6115
460.23	5	—	—	3.92	8546			8546
461.7	6.47	—	—	3.92	12580	0		12580
462.7	7.47	—	—	3.92	15606	1	696	16302
463.7	8.47	—	—	3.92	18843	2	1969	20812
464.7	9.47	—	—	3.92	22276	3	3617	25893
465.7	10.47	—	—	3.92	25896	4	5568	31464
466.7	11.47	—	—	3.92	29694	5	7782	37476
467.7	12.47	—	—	3.92	33660	6	10229	43889

$Q_s = 195\, C H^{3/2}$

$Q_d = 696\, H^{3/2}$

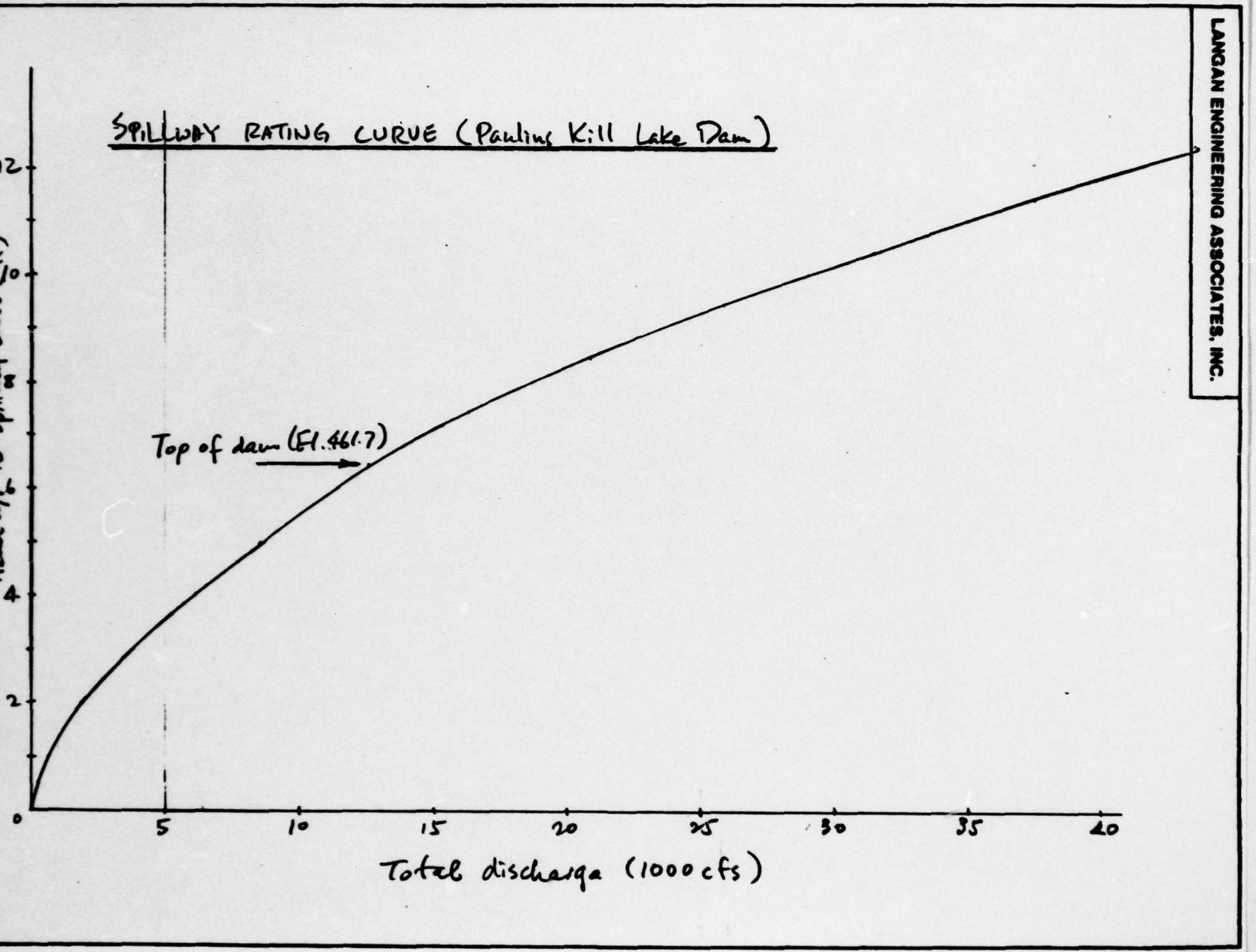
BY Dy DATE 2-22-79 Paulins Kill Lake Dam JOB NO. J-783B

CKD CED DATE 4-19-79 SHEET NO. 4 OF 10

LANGAN ENGINEERING ASSOCIATES, INC.

BY RHJ DATE 2-22-79 Paulins Kill Lake Dam JOB NO. 7-7838

CKD. JED DATE 4.19.79 SHEET NO. 5 OF 10



LANGAN ENGINEERING ASSOCIATES, INC.

Reservoir Storage Capacity

Assume a linear distribution for the area of the lake with elevation. Start at a zero storage at the crest of the spillway.

Area of Lake ≐ 170 Ac.

Length of equivalent square = 2721

Take average side slope ≐ 1V : 4H. (from lake topography)

∴ for every foot of water above the crest of spillway the length of equivalent square increases by

$= 1 \times 4 \times 2 = 8$ ft

Elev. (ft)	H (ft)	Length of equivalent square (ft)	Area of Lake (Acres)
455.23	0	2721	170
457.23	2	2737	172
459.23	4	2753	174
461.23	6	2769	176
463.23	8	2785	178
465.23	10	2801	180
467.7	12.47	2821	183

Storage capacity vs elevation is calculated by HEC-1 DB

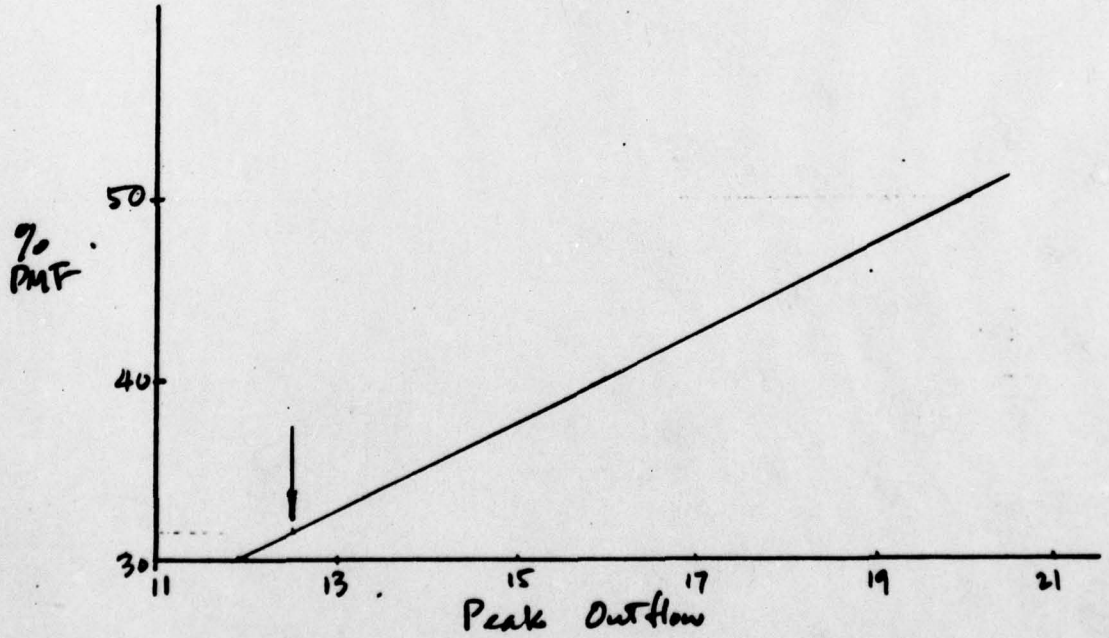
LANGAN ENGINEERING ASSOCIATES, INC.

SUMMARY OF HYDROGRAPH AND FLOOD ROUTING

1. Hydrograph and routing calculated using HEC-1 DB
2. PMF peak inflow for Paulins Kill Lake is 40207 cfs (routed to 40104 cfs)
3. Routing indicates that dam will overtop by approximately 5.4 ft for PMF

OVERTOPPING POTENTIAL

1. Various % of PMF has been routed using HEC-1 DB
2. Plot peak outflow vs % PMF



3. Dam overtops at approx. El. 461.7 with Q = 12580 cfs

∴ dam can pass approx. 32 % of PMF.

DRAWDOWN ANALYSIS

1. Outlet structure

One 36" sluiceway through spillway structure under footbridge pier.

(At time of inspection, considerable amount of sediment appeared to have deposited along upstream face of spillway, therefore sluiceway may have been blocked and gate non-operable. In this analysis, it is assumed the sediment cleared and gate functions properly.)

2. Outlet Capacity

Length of sluiceway = 15 ft

Invert of outlet = El 440.5 (for analysis, 440.23 used)

Discharge capacity based on

$$Q = A\sqrt{\frac{2gH}{1 + K_m + K_p L}}$$

Assume sluiceway has concrete surface

Take $n = 0.014$, $A = 7.07$ sq. ft

$K_p = 0.00839$, (NEH Section 5, ES-42)

Assume $K_m = 0.8$

$$\therefore Q = 7.07\sqrt{\frac{64.4H}{1 + 0.8 + 0.00839 \times 15}}$$

$$= 40.88\sqrt{H}$$

Elev (ft)	Head (ft)	Q (cfs)	Q out avg (cfs)
455.23	16	163.5	158.3
453.23	14	153.0	147.3
451.23	12	141.6	135.5
449.23	10	129.3	122.5
447.23	8	115.6	107.9
445.23	6	100.1	91.0
443.23	4	81.8	69.8
441.23	2	57.8	
440.23	0		

3. Storage capacity
   a. Assume capacity of lake at spillway crest (El. 455.23) ≈ 1000 Ac-ft.
   b. Assume area varies linearly with height
      Area of lake at El. 445.23 = 30 Ac.

Elev. (ft)	Area (Ac)	Δ Storage (Ac-ft)
455.23	170	312
453.23	142	256
451.23	114	200
449.23	86	144
447.23	58	88
445.23	30	

4. Assume inflow to be 2cfs/sq. mi

$Q_{in} = 2 \times .79 = 158$ cfs

Since this inflow is approx. equal to outflow of the 36" sluiceway when head at spillway crest, therefore the sluiceway is not capable of lowering the lake below spillway crest.


LAKE
Bear
Swamp
WARTSWOOD
LAKE
Little
Swartswood Lake
Lake
Kemah
Lake
Kill
Lake


LAKE OWASSA
CULVERS LAKE
Swamp
Lake Kemah
Lake Kemah
Paulina
Paulina
LEHIGH
LEHIGH


LAKE
Dry
Creek
NEW ENGLAND


LANDING STRIP
Golf Course
LAKE


Kill
Pauling
OLD RAILROAD GRADE
Upper Hudson
Lawrence Lake
GERMANY
Golf Course


ABANDONED
LEHIGH
RIVER
HUDSON RIVER
Blue Mountain
Blue Mountain
FLAT
White Lake
GERMANY
Wildcat
Hills
Hills
Pond
Wallkill
DRAINAGE

HEC-1 OUTPUT

PAULINS KILL LAKE DAM

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  11 JAN 79
**********

    1                A                          PAULINS KILL LAKE DAM
    2                A                          INFLOW HYDROGRAPH AND ROUTING
    3                A                          N.J. DAM INSPECTION
    4                B    100       2       0       0       0       0       0       0       0       0
    5                B1     3
    6                K              1                                       1
    7                K1   COMPUTE HYDROGRAPH
    8                M      1       1      79                      .862
    9                P             22.0      89     101     111     121
   10                T                                                     1     .15
   11                W    13.4     .62
   12                X      -2              1
   13                K      1       2                                      1
   14                K1   ROUTING COMPUTATIONS
   15                Y                              1
   16                Y1     1                                                    -1
   17                Y4455.23  456.23  457.23  458.23  459.23  460.23  461.7   462.7   463.7   464.7
   18                Y4 465.7   466.7   467.7
   19                Y5     0     665    1991    3810    6115    8546   12580   16302   20812   25893
   20                Y5 31464   37476   43889
   21                $A   170     172     174     176     178     180     183
   22                $E455.23  457.23  459.23  461.23  463.23  465.23  467.7
   23                $$455.23
   24                $D 461.7
   25                K     99


                PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                        RUNOFF HYDROGRAPH AT          1
                        ROUTE HYDROGRAPH TO           2
                        END OF NETWORK
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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 11 JAN 79
****

RUN DATE= 79/02/23.
TIME= 14.07.41.

PAULINS KILL LAKE DAM
INFLOW HYDROGRAPH AND ROUTING
N.J. DAM INSPECTION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	2	0	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			3	0	0	0			

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SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	79.00	0.00	79.00	.86	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	89.00	101.00	111.00	121.00	0.00	0.00

LOSS DATA

LKOPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 13.40 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 38 END-OF-PERIOD ORDINATES, LAG= 13.50 HOURS, CP= .62 VOL= 1.00

126.	463.	923.	1436.	1909.	2236.	2380.	2290.	2016.	1719.
1467.	1251.	1067.	910.	777.	662.	565.	482.	411.	351.
299.	255.	216.	186.	158.	135.	115.	98.	84.	72.
61.	52.	44.	38.	32.	28.	24.	20.		

3

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	2.00	1	.02	0.00	.02	158.	1.05	6.00	51	0.00	0.00	0.00	1053.
1.01	4.00	2	.02	0.00	.02	158.	1.05	8.00	52	0.00	0.00	0.00	921.
1.01	6.00	3	.02	0.00	.02	158.	1.05	10.00	53	0.00	0.00	0.00	809.
1.01	8.00	4	.07	0.00	.07	158.	1.05	12.00	54	0.00	0.00	0.00	705.
1.01	10.00	5	.07	0.00	.07	158.	1.05	14.00	55	0.00	0.00	0.00	617.
1.01	12.00	6	.07	0.00	.07	158.	1.05	16.00	56	0.00	0.00	0.00	542.
1.01	14.00	7	.40	0.00	.40	158.	1.05	18.00	57	0.00	0.00	0.00	415.
1.01	16.00	8	.81	.30	.51	195.	1.05	20.00	58	0.00	0.00	0.00	230.
1.01	18.00	9	.32	.02	.30	298.	1.05	22.00	59	0.00	0.00	0.00	164.
1.01	20.00	10	.03	0.00	.03	442.	1.06	0.00	60	0.00	0.00	0.00	161.
1.01	22.00	11	.03	0.00	.03	604.	1.06	2.00	61	0.00	0.00	0.00	160.
1.02	0.00	12	.03	0.00	.03	755.	1.06	4.00	62	0.00	0.00	0.00	158.
1.02	2.00	13	.25	0.00	.25	861.	1.06	6.00	63	0.00	0.00	0.00	158.
1.02	4.00	14	.25	0.00	.25	910.	1.06	8.00	64	0.00	0.00	0.00	158.
1.02	6.00	15	.25	0.00	.25	886.	1.06	10.00	65	0.00	0.00	0.00	158.
1.02	8.00	16	.76	.46	.30	860.	1.06	12.00	66	0.00	0.00	0.00	158.
1.02	10.00	17	.76	.46	.30	979.	1.06	14.00	67	0.00	0.00	0.00	158.
1.02	12.00	18	.76	.46	.30	1321.	1.06	16.00	68	0.00	0.00	0.00	158.
1.02	14.00	19	4.39	4.09	.30	2368.	1.06	18.00	69	0.00	0.00	0.00	158.
1.02	16.00	20	8.95	8.65	.30	5438.	1.06	20.00	70	0.00	0.00	0.00	158.
1.02	18.00	21	3.54	3.24	.30	11195.	1.06	22.00	71	0.00	0.00	0.00	158.
1.02	20.00	22	.38	.08	.30	18762.	1.07	0.00	72	0.00	0.00	0.00	158.
1.02	22.00	23	.38	.08	.30	26800.	1.07	2.00	73	0.00	0.00	0.00	158.
1.03	0.00	24	.38	.08	.30	33832.	1.07	4.00	74	0.00	0.00	0.00	158.
1.03	2.00	25	0.00	0.00	0.00	38555.	1.07	6.00	75	0.00	0.00	0.00	158.
1.03	4.00	26	0.00	0.00	0.00	40207.	1.07	8.00	76	0.00	0.00	0.00	158.
1.03	6.00	27	0.00	0.00	0.00	38510.	1.07	10.00	77	0.00	0.00	0.00	158.
1.03	8.00	28	0.00	0.00	0.00	34392.	1.07	12.00	78	0.00	0.00	0.00	158.
1.03	10.00	29	0.00	0.00	0.00	29668.	1.07	14.00	79	0.00	0.00	0.00	158.
1.03	12.00	30	0.00	0.00	0.00	25393.	1.07	16.00	80	0.00	0.00	0.00	158.
1.03	14.00	31	0.00	0.00	0.00	21710.	1.07	18.00	81	0.00	0.00	0.00	158.
1.03	16.00	32	0.00	0.00	0.00	18547.	1.07	20.00	82	0.00	0.00	0.00	158.
1.03	18.00	33	0.00	0.00	0.00	15844.	1.07	22.00	83	0.00	0.00	0.00	158.
1.03	20.00	34	0.00	0.00	0.00	13539.	1.08	0.00	84	0.00	0.00	0.00	158.
1.03	22.00	35	0.00	0.00	0.00	11572.	1.08	2.00	85	0.00	0.00	0.00	158.
1.04	0.00	36	0.00	0.00	0.00	9895.	1.08	4.00	86	0.00	0.00	0.00	158.
1.04	2.00	37	0.00	0.00	0.00	8464.	1.08	6.00	87	0.00	0.00	0.00	158.
1.04	4.00	38	0.00	0.00	0.00	7243.	1.08	8.00	88	0.00	0.00	0.00	158.
1.04	6.00	39	0.00	0.00	0.00	6202.	1.08	10.00	89	0.00	0.00	0.00	158.
1.04	8.00	40	0.00	0.00	0.00	5313.	1.08	12.00	90	0.00	0.00	0.00	158.

1.04	12.00	42	0.00	0.00	0.00	3909.	1.08	16.00	92	0.00	0.00	0.00	158.
1.04	14.00	43	0.00	0.00	0.00	3358.	1.08	18.00	93	0.00	0.00	0.00	158.
1.04	16.00	44	0.00	0.00	0.00	2888.	1.08	20.00	94	0.00	0.00	0.00	158.
1.04	18.00	45	0.00	0.00	0.00	2486.	1.08	22.00	95	0.00	0.00	0.00	158.
1.04	20.00	46	0.00	0.00	0.00	2139.	1.09	0.00	96	0.00	0.00	0.00	158.
1.04	22.00	47	0.00	0.00	0.00	1848.	1.09	2.00	97	0.00	0.00	0.00	158.
1.05	0.00	48	0.00	0.00	0.00	1599.	1.09	4.00	98	0.00	0.00	0.00	158.
1.05	2.00	49	0.00	0.00	0.00	1387.	1.09	6.00	99	0.00	0.00	0.00	158.
1.05	4.00	50	0.00	0.00	0.00	1207.	1.09	8.00	100	0.00	0.00	0.00	158.
									SUM	22.95	17.91	5.04	469982.
										(583.)	(455.)	(128.)	(13308.41)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	40207.	38397.	28325.	12585.	469826.
CMS	1139.	1087.	802.	356.	13304.
INCHES		4.52	13.34	17.78	18.44
MM		114.84	338.86	451.69	468.40
AC-FT		19040.	56181.	74888.	77657.
THOUS CU M		23485.	69299.	92373.	95789.

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HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	455.23	456.23	457.23	458.23	459.23	460.23	461.70	462.70	463.70	464.70
	465.70	466.70	467.70							
FLOW	0.00	665.00	1991.00	3810.00	6115.00	8546.00	12580.00	16302.00	20812.00	25893.00
	31484.00	37476.00	43889.00							
SURFACE AREA=	170.	172.	174.	176.	178.	180.	183.			
CAPACITY=	0.	742.	688.	1036.	1392.	1750.	2198.			
ELEVATION=	455.	457.	459.	461.	463.	465.	468.			

CREL	SPWID	COQW	EXPW	FLEVL	COQL	CAREA	EXPL
455.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
461.7	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	2.00	1	2.00	158.	77.	20.	455.3
1.01	4.00	2	4.00	158.	117.	30.	455.4
1.01	6.00	3	6.00	158.	137.	35.	455.4
1.01	8.00	4	8.00	158.	147.	38.	455.5
1.01	10.00	5	10.00	158.	152.	39.	455.5
1.01	12.00	6	12.00	158.	155.	40.	455.5
1.01	14.00	7	14.00	158.	157.	40.	455.5
1.01	16.00	8	16.00	195.	166.	43.	455.5
1.01	18.00	9	18.00	298.	206.	53.	455.5
1.01	20.00	10	20.00	442.	286.	73.	455.7
1.01	22.00	11	22.00	604.	401.	103.	455.8
1.02	0.00	12	24.00	755.	537.	138.	456.0
1.02	2.00	13	26.00	861.	671.	171.	456.2
1.02	4.00	14	28.00	910.	839.	193.	456.4
1.02	6.00	15	30.00	886.	885.	199.	456.4
1.02	8.00	16	32.00	860.	876.	198.	456.4
1.02	10.00	17	34.00	979.	910.	202.	456.4
1.02	12.00	18	36.00	1321.	1097.	226.	456.6
1.02	14.00	19	38.00	2368.	1680.	302.	457.0
1.02	16.00	20	40.00	5436.	3689.	503.	458.2
1.02	18.00	21	42.00	11195.	8573.	864.	460.2
1.02	20.00	22	44.00	18762.	16198.	1293.	462.7
1.02	22.00	23	46.00	26800.	25257.	1632.	464.6
1.03	0.00	24	48.00	33832.	32536.	1867.	465.9
1.03	2.00	25	50.00	38555.	37903.	2028.	466.8
1.03	4.00	26	52.00	40207.	40104.	2090.	467.1
1.03	6.00	27	54.00	38510.	38995.	2059.	466.9
1.03	8.00	28	56.00	34392.	35244.	1949.	466.3
1.03	10.00	29	58.00	29668.	30550.	1805.	465.5
1.03	12.00	30	60.00	25393.	26208.	1665.	464.8
1.03	14.00	31	62.00	21710.	22476.	1534.	464.0
1.03	16.00	32	64.00	18547.	19241.	1414.	463.4
1.03	18.00	33	66.00	15844.	16472.	1304.	462.7
1.03	20.00	34	68.00	13539.	14202.	1198.	462.1
1.03	22.00	35	70.00	11572.	12164.	1094.	461.5
1.04	0.00	36	72.00	9895.	10553.	991.	461.0
1.04	2.00	37	74.00	8464.	9004.	892.	460.4
1.04	4.00	38	76.00	7243.	7749.	805.	459.9
1.04	6.00	39	78.00	6202.	6650.	726.	459.4
[illegible]	[illegible]	[illegible]	[illegible]	5313.	5704.	[illegible]	[illegible]

1.04	10.00	41	82.00	4556.	4899.	596.	458.7
1.04	12.00	42	84.00	3909.	4201.	544.	458.4
1.04	14.00	43	86.00	3358.	3629.	497.	458.1
1.04	16.00	44	88.00	2888.	3158.	453.	457.9
1.04	18.00	45	90.00	2486.	2719.	411.	457.6
1.04	20.00	46	92.00	2139.	2340.	375.	457.4
1.04	22.00	47	94.00	1848.	2017.	344.	457.2
1.05	0.00	48	96.00	1599.	1784.	315.	457.1
1.05	2.00	49	98.00	1387.	1558.	286.	456.9
1.05	4.00	50	100.00	1207.	1355.	260.	456.8
1.05	6.00	51	102.00	1053.	1179.	237.	456.6
1.05	8.00	52	104.00	921.	1029.	217.	456.5
1.05	10.00	53	106.00	809.	901.	201.	456.4
1.05	12.00	54	108.00	705.	789.	186.	456.3
1.05	14.00	55	110.00	617.	689.	174.	456.2
1.05	16.00	56	112.00	542.	627.	161.	456.2
1.05	18.00	57	114.00	415.	555.	142.	456.1
1.05	20.00	58	116.00	230.	442.	113.	455.9
1.05	22.00	59	118.00	164.	322.	82.	455.7
1.06	0.00	60	120.00	161.	244.	63.	455.6
1.06	2.00	61	122.00	160.	204.	52.	455.5
1.06	4.00	62	124.00	158.	182.	47.	455.5
1.06	6.00	63	126.00	158.	170.	44.	455.5
1.06	8.00	64	128.00	158.	164.	42.	455.5
1.06	10.00	65	130.00	158.	161.	41.	455.5
1.06	12.00	66	132.00	158.	160.	41.	455.5
1.06	14.00	67	134.00	158.	159.	41.	455.5
1.06	16.00	68	136.00	158.	158.	41.	455.5
1.06	18.00	69	138.00	158.	158.	40.	455.5
1.06	20.00	70	140.00	158.	158.	40.	455.5
1.06	22.00	71	142.00	158.	158.	40.	455.5
1.07	0.00	72	144.00	158.	158.	40.	455.5
1.07	2.00	73	146.00	158.	158.	40.	455.5
1.07	4.00	74	148.00	158.	158.	40.	455.5
1.07	6.00	75	150.00	158.	158.	40.	455.5
1.07	8.00	76	152.00	158.	158.	40.	455.5
1.07	10.00	77	154.00	158.	158.	40.	455.5
1.07	12.00	78	156.00	158.	158.	40.	455.5
1.07	14.00	79	158.00	158.	158.	40.	455.5
1.07	16.00	80	160.00	158.	158.	40.	455.5
1.07	18.00	81	162.00	158.	158.	40.	455.5
1.07	20.00	82	164.00	158.	158.	40.	455.5
1.07	22.00	83	166.00	158.	158.	40.	455.5
1.08	0.00	84	168.00	158.	158.	40.	455.5
1.08	2.00	85	170.00	158.	158.	40.	455.5
1.08	4.00	86	172.00	158.	158.	40.	455.5
1.08	6.00	87	174.00	158.	158.	40.	455.5
1.08	8.00	88	176.00	158.	158.	40.	455.5
1.08	10.00	89	178.00	158.	158.	40.	455.5
1.08	12.00	90	180.00	158.	158.	40.	455.5
1.08	14.00	91	182.00	158.	158.	40.	455.5

1.07	16.00	92	184.00	158.	158.	40.	455.5
1.08	18.00	93	186.00	158.	158.	40.	455.5
1.08	20.00	94	188.00	158.	158.	40.	455.5
1.08	22.00	95	190.00	158.	158.	40.	455.5
1.09	0.00	96	192.00	158.	158.	40.	455.5
1.09	2.00	97	194.00	158.	158.	40.	455.5
1.09	4.00	98	196.00	158.	158.	40.	455.5
1.09	6.00	99	198.00	158.	158.	40.	455.5
1.09	8.00	100	200.00	158.	158.	40.	455.5

PEAK OUTFLOW IS 40104. AT TIME 52.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	40104.	38557.	28349.	12584.	469702.
CMS	1136.	1092.	803.	356.	13300.
INCHES		4.54	13.35	17.78	18.44
MM		115.32	339.15	451.65	468.27
AC-FT		19119.	56229.	74880.	77637.
THOUS CU M		23583.	69357.	92363.	95763.

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RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	40207.	38397.	28325.	12585.	79.00
		(1138.55)(1087.29)(802.07)(356.38)(204.61)				
ROUTED TO	2	40104.	38557.	28349.	12584.	79.00
		(1135.61)(1091.82)(802.75)(356.34)(204.61)				

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	455.23	455.23	461.70
STORAGE	0.	0.	1121.
OUTFLOW	0.	0.	12580.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.00	467.11	5.41	2090.	40104.	26.00	52.00	0.00

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 11 JAN 79
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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  11 JAN 79
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RUN  DATE= 79/02/23.
     TIME= 15.03.43.
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PAULINS KILL LAKE DAM
% PMF
N.J. DAM INSPECTION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	2	0	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1

RTIOS=	1.00	.50	.40	.30	.20	.10

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SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	79.00	0.00	79.00	.86	0.000	0	0	0

PRECIP DATA

SPFF	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	89.00	101.00	111.00	121.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 13.41 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 38 END-OF-PERIOD ORDINATES, LAG= 13.50 HOURS, CP= .62 VOL= 1.00

126.	463.	923.	1436.	1909.	2236.	2380.	2290.	2016.	1719.
1467.	1251.	1067.	919.	777.	662.	565.	482.	411.	351.
299.	255.	218.	186.	158.	135.	115.	98.	84.	72.
61.	52.	44.	38.	32.	28.	24.	20.		

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	22.95	17.91	5.04	469982.
										(583.)	(455.)	(128.)	(13308.41)

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HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	455.23	456.23	457.23	458.23	459.23	460.23	461.70	462.70	463.70	464.70
	465.70	466.70	467.70							
FLOW	0.00	665.00	1991.00	3810.00	6115.00	8546.00	12580.00	16302.00	20812.00	25893.00
	31464.00	37476.00	43889.00							
SURFACE AREA=	170.	172.	174.	176.	178.	180.	183.			
CAPACITY=	0.	342.	688.	1038.	1392.	1750.	2198.			
ELEVATION=	455.	457.	459.	461.	463.	465.	468.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
455.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
461.7	0.0	0.0	0.

PEAK OUTFLOW IS 40104. AT TIME 52.00 HOURS

PEAK OUTFLOW IS 19995. AT TIME 52.00 HOURS

PEAK OUTFLOW IS 15954. AT TIME 52.00 HOURS

PEAK OUTFLOW IS 11910. AT TIME 52.00 HOURS

PEAK OUTFLOW IS 7915. AT TIME 52.00 HOURS

PEAK OUTFLOW IS 3956. AT TIME 54.00 HOURS

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .20	RATIO 6 .10
HYDROGRAPH AT	1	79.00	1	40207.	20104.	16083.	12062.	8041.	4021.
	(	204.61)		(1138.55)(	569.27)(	455.42)(	341.56)(	227.71)(	113.85)(
ROUTED TO	2	79.00	1	40104.	19995.	15954.	11910.	7915.	3936.
	(	204.61)		(1135.61)(	566.18)(	451.76)(	337.24)(	224.14)(	111.47)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	455.23	455.23	461.70
STORAGE	0.	0.	1121.
OUTFLOW	0.	0.	12580.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	467.11	5.41	2090.	40104.	26.00	52.00	0.00
.50	463.52	1.82	1443.	19995.	14.00	52.00	0.00
.40	462.61	.91	1281.	15954.	8.00	52.00	0.00
.30	461.46	0.00	1078.	11910.	0.00	52.00	0.00
.20	459.97	0.00	817.	7915.	0.00	52.00	0.00
.10	458.28	0.00	524.	3936.	0.00	54.00	0.00

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 11 JAN 79
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APPENDIX 4

REFERENCES

PAULINS KILL LAKE DAM

APPENDIX 4

REFERENCES

PAULINS KILL LAKE DAM

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